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A MANUAL

OF

MARINE ZOOLOGY

FOR

The British Isles.

LONDON:
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A MANUAL

OF

MARINE ZOOLOGY

FOR

The British Isles.

BY

PHILIP HENRY GOSSE, A.L.S.

"And God said, Let the waters bring forth abundantly the moving creature that hath life; . . . . . and God saw that it was good."—*Gen.* i. 20, 21.

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PART I.

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PREFACE.

It is now about four-and-twenty years ago, that, in a land far remote from this, I began the study of systematic zoology, with Insects. It is, beyond all comparison, the most extensive Class of animals, in fact all but boundless; but in my ignorance I attacked it entire and indivisible, collecting and trying hard to identify everything that I found, from the *Cicindela* to the *Podura*. I had not an atom of assistance toward the identification, but the brief, highly condensed, and technical generic characters of Linnæus's "Systema Naturæ," over which I puzzled my brains, specimens in hand, many an hour. Of course there was much darkness, there were many egregious blunders; but perseverance did a good deal, and I have never regretted the time spent in that exercise. The leading forms of that great Class were familiarized to me in a way that they never would have been, if I had merely learned their names from coloured engravings, or from the oral information of some more learned friend; and what was of far

145254

greater value, I acquired the habit of comparing structure with structure, of marking minute differences of form, and became in some measure accustomed to that precision of language, without which descriptive natural history could not exist.

I have endeavoured in the following pages to furnish to the sea-side naturalist, what the Linnean *Genera Insectorum* were to me. That such a book is a desideratum, I need hardly say. Many a time have I been asked to indicate some published work, whereby the student who picks up a shell from the beach, or a worm from under stones at low water, may know what it is that he has found. I might indeed point to the admirable works of Yarrell, of Forbes, of Johnston, of Baird, of Bell, of Busk, and others who have written Monographs of particular classes or groups. But this is not what is wanted;—the information required is scattered through so large a number of volumes, that a book-case needs to form a part of the sea-side visitor's luggage. Moreover, to persons of limited income the expense of these works often forms an insuperable bar to their possession. Thirty pounds would not purchase the books necessary for the identification of the marine animals of Britain; while if this sum were expended, there would still remain gaps of awful width,—whole Classes, for the recognition of which *no English book is extant.* I need only

mention the *Foraminifera*, the Covered-eyed, and Ciliograde *Medusæ*, the *Turbellaria*, the Sessile-eyed *Crustacea*, the *Annelida*, and a portion of the *Polyzoa*, in proof of this alleged deficiency.

Let it not be supposed that I think lightly of the Monographs I have alluded to. I should only convict myself of gross ignorance if I were to do so. They are of the highest value,—models of scientific research, acumen, and accuracy; but the very care and labour which have been bestowed upon them, to give them the perfection they confessedly possess, have necessarily put them (as a whole body of science) out of the reach of the great multitude of students. My little book is not a rival, but an introduction, to these elaborate works. It is a Manual, that can be carried in the pocket, and referred to, as the tyro sits upon a weed-fringed rock, or stands on the tide-washed beach.

I do not speak theoretically only, but experimentally, when I say that such a work as this is a felt need. Most of the books I have alluded to above, are in my own library, but still I have often felt the want of a Manual, which should contain the characters of every Class, Order, Tribe, Family, and Genus, of our native marine animals, so arranged as to be suitable for ready reference. The Manual did not exist, and I set myself to make it.

I believe the student will find here the means

of learning, with as little trouble and doubt as possible, the generic name of *every animal* that has been recognised by naturalists as inhabiting the British seas; from the lowest Sponge, up to the Whale. To this universality there are only these exceptions:—

1. That the Intestinal Worms (ENTOZOA) are not included. Properly speaking, they are no more marine, than they are terrestrial animals; for though some of them live in marine animals, their proper sphere is not the water or the land, but the living tissues of other creatures; they have a world of their own.

2. That the swarming millions of animalcules, known as INFUSORIA, which the microscope reveals in the sea, as well as in fresh water, I have not included in detail; for reasons which will be found under the head of this Class.

Knowing by experience the difficulties which lie in the way of identifying animals by published characters, I have laboured to remove, or to lessen those difficulties as far as was possible. I have endeavoured to make these pages practically useful to the beginner, while yet they should be precise enough to serve the advanced zoologist as a convenient medium of reference. Many of the difficulties in the path of science are not inseparable from it; the language used is often unnecessarily technical, and yet, strange to say, loose withal.

Thus we sometimes find one species described as having "the fore limbs short," and the next, which is to be distinguished from it, not as having "the fore limbs long," but "the anterior extremities elongated." Sometimes in the long descriptions which must be waded through, and carried in mind, the head in one case is mentioned first, then the tail, then the trunk, the limbs, and so on: but in the succeeding example, which has to be compared with it, perhaps the limbs come first, then the head, then the trunk, &c. Such difficulties as these are most perplexing; and yet it is easy to see that a little care might entirely remove them. If a certain order were maintained in the details of description of kindred forms, and a fixed phraseology, I need not point out how much the work of comparison would be lightened.

In the wording of the following definitions I have endeavoured to make the phraseology as Saxon as possible. I am far from desiring to rob our language of its Latin element; it would be greatly impoverished by such a privation; and multitudes of words of Latin derivation are as familiar as the homeliest Anglo-Saxon. Still our scientific language might be much more Saxonised than it is, without losing that precision which is indispensable.

On the other hand, the student must bear in mind that so many of the *ideas themselves* in

modern science are new, and custom has so generally affixed to these new ideas classical expressions, that it would be both absurd and often unintelligible to substitute homelier expressions for them—to exchange, for example, such words as *thorax*, *abdomen*, *oval*, for *chest*, *belly*, *egg-shaped*; that others, as *homogeneous*, *parasitic*, *truncate*, &c. can be otherwise expressed only by using many words; and that not a few, as *cilia*, *tentacle*, *antennæ*, have really no correspondent words in Saxon English.

I have, however, added a glossary for the explanation of such technical terms as were unavoidable; or else have taken care to expound them on their first occurrence. With these aids I trust there is not an expression in the book which a person of average English education will not understand.

But what I consider the principal feature of this work is the copiousness and character of its illustration. Perhaps I may say that I have enjoyed more than ordinary facilities for a labour of this kind. Having been accustomed from childhood to draw animals from the life, I have accumulated in my portfolios about *three thousand figures* of animals or parts of animals, all drawn by myself from nature, of which about two thousand five hundred are of the Invertebrate Classes, and about half of these done under the microscope. The

portion of the work now issued (Part I.) contains figures of three hundred and forty species,—*a figure of every genus named*,—of which one hundred and twenty are drawn from living, and one hundred and two from preserved specimens. Those who are familiar with the subject will, I trust, acquit me of vain-glory in affirming that upwards of a hundred figures taken from *living* animals in these low forms, constitutes a somewhat unusual feature in a book of this size and price. Of the *character* of the figures I must leave others to judge.

The entire work will consist of two Parts, each complete in itself. Part I., now issued, includes the following Classes:—

I. Poriphora.
II. Infusoria.
III. Rhizopoda.
IV. Zoophyta.
V. Acalepha.
VI. Echinodermata.
VII. Turbellaria.
VIII. Annelida.
IX. Rotifera.
X. Crustacea.
XI. Cirripedia.
XII. Arachnida.
XIII. Insecta.

Part II. is in a state of forwardness, and will be published as soon as possible. It will include the following Classes:—

XIV. Polyzoa.
XV. Tunicata.
XVI. Brachiopoda.
XVII. Conchifera.
XVIII. Gasteropoda.
XIX. Pteropoda.
XX. Cephalopoda.
XXI. Pisces.
XXII. Mammalia.

P. H. G.

London, *July* 1855.

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MARINE ZOOLOGY.

Sub-Kingdom I. PROTOZOA.

Class I. PORIPHORA.

(Sponges.)

These are the lowest grades of animal life, so close to the border of the vegetable kingdom, that it is difficult to determine of some species whether they are on the one or the other side. To the unassisted sense they seem mere lifeless masses; without organs, without feeling, without function, and many of them without form,—woolly masses of fibres more or less compacted, and steeped in jelly.

Several of them, however, if viewed with a lens while in a living state, under water, display vigorous currents constantly pouring forth from certain orifices; and we necessarily infer that the water thus ejected must be as constantly taken in through some other channel. On tearing the mass open, we see that the whole substance is perforated in all directions by irregular canals leading into each other; of which some are slender and communicate with the surface by minute but numerous pores, and others are wide, and open by ample orifices. Through the former the water is admitted; through the latter it is ejected.

Recent observations made by Mr. Bowerbank have shown that these currents are produced by *cilia* or whip-like threads within the canals, which maintain a waving or lashing motion in a given direction. The canals themselves are formed by the arrangement of the fibres which give solidity to the Sponge, and these are either horny, variously branched and interlaced, or crystal-like, composed of lime or flint, and resembling in shape needles, pins, or stars. These bodies (*spicula*) often exist in immense numbers. Both the fibres and the *spicula* are invested with a glairy coat of living jelly, which is the organic or fleshy part, but which has so little consistence as often to run off in streams when the Sponge is taken from its element.

Localities, &c.—The surfaces of rocks, the under sides of stones at low water, the interior of caverns that are washed by the tide, and various objects from deep water, are generally coated with Sponges of many species; and some of the more delicate adhere to sea-weeds. The curious genus Cliona inhabits branching cavities in shells, which it lines with its bright yellow flesh: these cavities it excavates by the aid of the sharp angles and cutting edges of the flinty granules which stud its surface, as has been proved by Mr. Albany Hancock, who has greatly added to the number of known species.

Identification.—The texture, whether compact or loose, woody or spongy, woolly or gelatinous; the general form; the surface; the orifices; and in particular the *spicula*, whether composed of flint or lime (to be determined by testing them with acids), and whether simple or starred; and, if the

latter, what is the prevalent number of the rays; —are the principal points to be observed.

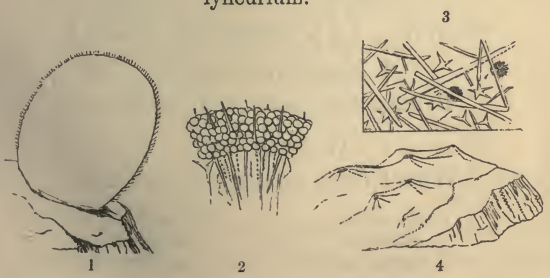
Authorities.—Dr. Johnston's "History of British Sponges" is far beyond any other yet published; and to it I am chiefly indebted for the following arrangement. It is, however, imperfect; and the scientific world is expecting from the pen of Mr. Bowerbank a revision of the Class, which his experience renders him more competent to give than any other zoologist living.

PORIPHORA.

Bodies of various form, sometimes more or less constant and regular, at others uncertain and irregular; always fixed; composed of horny fibres, or of spicula of lime or flint, endued with a glairy coat of gelatinous granules, so arranged as to form permeating canals, through which water is circulated by the action of lining cilia.

Tethea (Lamarck). Solid and compact, rounded, covered with a skin; without sensible pores; interior fleshy, with spicula of flint arranged in bundles, radiating from a central nucleus.

T. cranium. Fig. 1.
lyncurium.



Geodia (Lamk.). Solid, permeated with sinuous canals; covered with a solid crust formed of globules of flint. Otherwise as *Tethea*.

G. Zetlandica. Fig. 2, *a slice magnified.*

Pachymatisma (Bowerbank). Fleshy, crust-like, not cellular nor elastic, covered with a thick skin, perforated by scattered orifices: interior beset with flinty spicula both needle-shaped and starred.

P. Johnstonia. Fig. 3, *spicula magnified.*

Halichondria (Fleming). Spongy, elastic, variously formed; surface porous, studded with orifices, not slimy; substance of horny and flinty threads woven into a network, or of simple flinty spicula crossed and netted together, by a gelatinous flesh.

* With a fibrous texture; the spicula imbedded in the fibres.

† Branched or stalked.

H. palmata.
oculata.
cervicornis.
H. hispida.
ramosa.

†† Many-formed.

H. Montagui.
Columbæ.
H. plumosa.
fruticosa.

** With a texture like that of bread.

† Regularly formed.

H. infundibuliformis.
H. ventilabrum.

†† Shapeless.

‡ With spicula pointed at each end.

H. simulans.
cinerea.
albescens.
H. panicea. Fig. 4.
areolata.
aculeata.

‡‡ With spicula knobbed at one end.

H. fucorum.
incrustans.
saburrata.
ægagropila.

H. seriata.
sanguinea.
macularis.
hystrix.

*** With a hard, solid, homogenous texture.

H. coalita.
virgultosa.
hirsuta.
suberea.
mamillaris.

H. ficus.
carnosa.
sevosa.
maculans.

**** Of doubtful place.

H. aurea.
conus.

H. rigida.
perlevis.

Cliona (Grant). Branched or lobed, burrowing into shells, corals or stones, communicating with the exterior by mouths protruding through circular holes in the surface of the foreign body; interior with anastomosing tubes, and flinty spicula; surface covered with crystalline bodies composed of flint.

C. celata.
gorgonioides. Fig. 5.
gracilis.
Howsei.
Northumbrica.

C. Alderi.
corallinoides.
lobata.
vastifica.

5

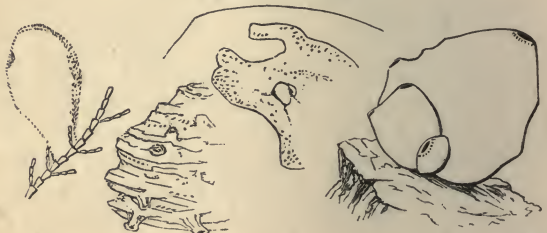
Spongia (Linnæus). Porous, elastic; network

formed solely of horny threads; mouths not opening in elevated warts.

S. pulchella.
limbata. Fig. 5*.
lævigata.

Dysidea (Johnston). Sessile, imperfectly cellular, shapeless, composed of a gelatinous membrane containing particles of sand; spicula few, of no certain figure.

D. fragilis.
papillosa. Fig. 6.



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Halisarca (Dujardin). Spreading as a thin gelatinous crust on rocks and shells, semitransparent, without spicula or distinct canals.

H. Dujardinii. Fig. 7.

Grantia (Flem.). Firm, inelastic, usually white, variously formed; texture close, but porous; spicula calcareous, simple and starred; mouths distinct.

* Hollow.

G. compressa. Fig. 8.
lacunosa.
ciliata.
G. pulverulenta.
fistulosa.
botryoides.

** Incrusting.

G. nivea.
G. coriacea.

Class II. INFUSORIA.

Of this very extensive group of living beings a large number are marine; and the slightest examination, with a pocket lens, of sea-water that has been kept for a little while in an aquarium, proves that these creatures exist in considerable variety in our own seas. But no naturalist, that I am aware of, has as yet attempted the great work of identifying and discriminating the British Infusoria; and the only help to the student that exists for this object is the magnificent "Die Infusions-Thierchen" of Professor Ehrenberg, or Mr. Pritchard's abridged translation of it, "A History of Infusoria, living and fossil."

But since the publication of that great work, important alterations have been made in the limits of the class; and the whole group, as a legitimate division of the Animal Kingdom, is in abeyance. Whole genera have been shown to be only the young stages of higher animals, as *Bursaria*, *Paramecium*, &c., which are the larvæ of certain *Planariæ*, and others have proved to be *vegetables*, endued with spontaneous motion. Hence, though I do not go so far as those who believe that the whole group will ultimately be resolved into other classes, I agree with Dr. Burnett in regarding "the Infusoria as in a completely transition state; and although it may be well to arrange these forms systematically, for the sake of convenience, yet they cannot be considered as holding fixed zoological positions." *

* Siebold's Anat. of Invertebr. (Amer. Ed.)

Class III. RHIZOPODA.

These are microscopic animals closely allied to the Infusoria, of very simple structure, consisting of little more than a transparent glaire or thin jelly. They have, however, the power of throwing out from various parts of the surface long tenacious threads of the common jelly, which are irregularly connected and branched, and which are completely retractile at the will of the animal.

Some of these beings are entirely unprotected by any covering, and others are enveloped in a horny case or box, which has several openings for the emission of the processes. Specimens of both of these kinds are common in our fresh waters, constituting the genera *Amœba*, *Difflugia*, *Arcella*, &c. Others, however, and these by far the greater number, secrete a calcareous shell, analogous to that of the Mollusca, which is moulded upon the gelatinous body, and is perforated with minute orifices, for the purpose above mentioned. This last character has given to the shell-bearing Rhizopoda the name of Foraminifera.

In the simplest forms the shell has but a single chamber; in others chamber after chamber is added to the first, each connected with the preceding ones by a tube or aperture, though it is the last only which is inhabited. This addition may be made in a straight or curved line, or in one rolled on itself in a flat or oblique plane, and in one or more series, or in an irregularly crowded manner.

The species are few in our seas; but in those of warm climates, as in the Mediterranean, they are much more numerous; but all the existing kinds put together dwindle into insignificance when compared to the almost incredible profusion in which the Class existed in the ancient seas of the secondary and tertiary epochs. Their fossil shells form almost the entire bulk of extensive mountains; Paris is completely based on FORAMINIFERA; and the extent to which they are crowded together can only be compared to that of the grains in a heap of corn. Plancus found 6,000 specimens in an ounce of sand from the Adriatic, but D'Orbigny estimates the same quantity of sand from the Caribbean sea to contain the inconceivable number of 3,840,000 shells! It is needless to add that these must be of excessive minuteness, as are most of the recent species; some of the fossil *Nummulinæ*, however, are of the size of a crown-piece.

Localities, &c.—The living species are found adhering to sea-weeds, and branching zoophytes. I have obtained *Polystomella crispa* and *Polymorphina oblonga* on the Dorset coast, by plucking up at random, from the verge of low water, tufts of the common Coralline, of *Rhytiphlea*, &c., and putting them into a glass vase of sea-water. The FORAMINIFERA will crawl out and adhere to the sides of the glass, where they must be searched for with a lens.

Identification.—The number and arrangement of the chambers; and the nature, form, position and direction of the orifice, afford the chief grounds for the sub-division of the group.

Zoological Rank. — Considerable diversity of opinion exists on this point among naturalists.

Formerly the FORAMINIFERA were supposed, chiefly from their chambered shells, to be allied to the highest forms of the MOLLUSCA, but that opinion has long been abandoned. Professors Ehrenberg and Williamson, however, still associate them with that great Sub-kingdom, but in its very lowest rank; judging that the structure of the shell displays essential affinity to that of the calcareous cells of *Eschara*, &c., among the POLYZOA. D'Orbigny places the Class between the ZOOPHYTA and the ECHINODERMATA. But for the present I prefer to adhere to the views of Dujardin, Siebold, and others, who ally them to the INFUSORIA. The *Noctiluca miliaris*, which sometimes occurs in countless millions in our seas in summer, holds a most debateable position. Formerly it was included among the *Medusæ*, with which it certainly has no affinity; Mr. Huxley considers it an *Infusorium*, and M. Doyere suggests its analogy to the simple, shell-less RHIZOPODA.

Authorities.—For the arrangement of the genera, I have followed D'Orbigny (*Art.* FORAMINIFERES in the Dict. des Sci. Nat.); but the identification of recent British species was a work for which I knew of no published help. It is understood that Dr. Carpenter and Professor Williamson are both engaged on the British FORAMINIFERA, and the latter has published a Memoir on the *Lagenæ*, which I have used. For the rest, I have received the kind and valuable assistance of Mr. T. Rupert Jones, who has furnished me, at the cost of much time and labour, with a list of British species which he believes to be recent. Many of those whose shells are found in our seas he believes to be fossil, washed down from sea-side cliffs.

Sub-class Foraminifera.

Microscopic animals; not aggregated; of glutinous consistence; rounded, or divided into segments, placed in a line, or rolled spirally; enveloped in a shell, which is modelled on the form of the body; giving off, through orifices in the shell, soft filaments, which are contractile, colourless, very long, branched, and used for locomotion.

Body composed of one segment; shell of one chamber . . . . . *Monostegia.*
Body of segments placed in one line; shell of chambers built up end to end in a straight or curved line . . . . . *Stichostegia.*
Body of segments rolled in a spiral; chambers of shell piled on one axis, in a spiral. . *Helicostegia.*
Body of alternate segments forming a spiral; shell-chambers piled on two axes, alternating, and rolled in a spiral. . . . . *Entomostegia.*
Body of alternate segments crowded together, not in a spiral: chambers alternate, crowded, on two or three axes, not forming a spiral . . . . . *Enallostegia.*
Body of segments twined (*par pelotonnement*) round an axis; chambers similar, each making a half-circumvolution . . . . . *Agathistegia.*

Order I. MONOSTEGIA.

Lagena (Walker). Cell calcareous, single, globular, ovate, or cylindrical, with a long external tubular neck projecting from the upper extremity.

L. lævis.
gracilis.
L. striata. Fig. 9; *mag.* $\frac{90}{1}$
substriata.

Entosolenia (Ehrenberg). As *Lagena*, but the tube projects downwards into the cavity of the cell.

E. globosa.
squamosa.
E. lineata.
marginata. Fig. 10. section; $\frac{200}{1}$.

Order II. STICHOSTEGIA.

Dentalina (D'Orbigny). Animal free in the shell; shell regular, equal-sided, slightly bowed, with a single central round orifice.

D. recta. Fig. 11; $\frac{5}{1}$.
? subarenata.

Order III. HELICOSTEGIA.

Nonionina (D'Orb.). Shell equal-sided, spire rolled in the same plane; orifice single, against the return of the spire, always visible.

N. crassula. Fig. 12; *mag.*

Polystomella (Lamk.). Orifices numerous, on the last chamber, and on the sides of the shell; chambers simple, furnished with one sole cavity.

P. crispa. Fig. 14; $\frac{20}{1}$. Gulielminæ.
P. crenatula. nautilina.

Rotalina (D'Orb.). Shell unequal-sided, spire rolled obliquely, and completely formed; orifice simple, crescent-shaped, on the last chamber only, on the middle of its breadth.

R. Beccarii. Fig. 13; $\frac{25}{1}$.

Globigerina (D'Orb.). As *Rotalina*, but the orifice is at the umbilical angle.

G. inflata. Fig. 15; *mag.*

Truncatulina (D'Orb.). As *Rotalina*, but the orifice is a slit continued from one chamber to another, on the spiral side.

T. lobatula. Fig. 20; *mag.*

UNIVERSITY OF CALIFORNIA

Order V. ENALLOSTEGIA.

Polymorphina (D'Orb.). Shell with unequal sides, without corresponding parts; alternation of the chambers upon two faces; orifice round, terminal.

P. lactea.
oblonga. Fig. 16; $\frac{6}{1}$.
? rotundata.

Order VI. AGATHISTEGIA.

Spiroloculina (D'Orb.). Shell equal-sided, formed of corresponding parts; chambers aggregated on two opposing faces, all of them apparent, not embracing.

S. concentrica. Fig. 17; $\frac{10}{1}$.

Triloculina (D'Orb.). Shell unequal-sided, formed of parts not corresponding; aggregation on three opposing faces.

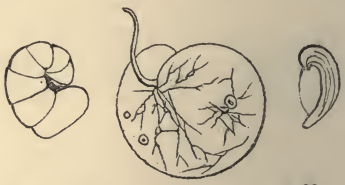
T. striata.
oblonga. Fig. 19; $\frac{1^{2}}{1}$.

Quinqueloculina (D'Orb.). As *Triloculina*, but the aggregation on five opposing faces; five chambers apparent at all ages.

Q. seminulum.
subrotunda. Fig. 18; $\frac{5}{1}$.

Adelosina (D'Orb.). As *Quinqueloculina*, but the five chambers are apparent only in the adult state.

A. bicornis. Fig. 22; $\frac{8}{1}$.



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Genus of uncertain place.

Noctiluca (Suriray). Shell-less; covered with a transparent membrane; globose, but slightly two-lobed; with a flexible tentacle, but without changeable processes; swimming freely in the sea; luminous.

N. miliaris. Fig. 21; $\frac{2^{5}}{1}$.

Sub-Kingdom II. RADIATA.

Class I. ZOOPHYTA.

(Polypes.)

The animals of this Class have a well-defined form, though a more or less changeable one; a form of which the most obvious characteristic is, that the various organs are arranged in a radiate or circular manner round a centre. In the simplest state one of these animals consists of a fleshy bag, opening only at one end, around which is placed a crown of slender contractile threads called tentacles, while the other end forms an adhesive disk by which the creature attaches itself to other objects. This is the condition of the *Hydra*, the *Clava*, &c.

A number of species have the power of secreting an investing tube of a horny nature, in which the fleshy body can move up and down, expanding its tentacles, like a star, over the top. Others give forth buds at intervals, each of which takes the form of a polype; and these being permanent, give a shrub-like or branched aspect to the animal, which then is a compound polype. The tube is branched conformably, and the orifices from which the polypes expand are usually dilated into cups

or cells. This is the condition of the *Sertulariadæ* and the *Plumulariadæ*.

Others are not enclosed in a tube, but deposit in the substance of the flesh crystal-like *spicula* of lime, somewhat like those of the Sponges, which serve to stiffen and support the mass, as the *Alcyonium* or "Cow's-pap." The extensive group known popularly as Sea-anemones, or Animal-flowers, from the blossom-like appearance of their expanded disks and tentacles, and their gorgeous colours, are more fleshy, but are destitute of any solid parts; while the Madrepores have a skeleton composed of stony plates set up edgewise, and imbedded in the flesh in a radiating fashion round the centre. Finally, the *Gorgoniæ* are long and slender, with a flexible axis of horny or wood-like substance.

Most, if not all, of these Polypes have the power of arresting, by a touch of their bodies, other animals much higher in rank than themselves, and of instantly benumbing them, so that they may be sucked in and devoured without resistance. This power resides in highly elastic threads or wires, which are doubtless connected with a subtile poison, and are ordinarily coiled up in oval capsules, but are, at the will of the animal, projected with surprising force. These capsules are lodged in vast numbers in the flesh of the body, but especially in the tentacles.*

Localities, &c.—The *Tubulariadæ* and *Sertulariadæ* are for the most part found growing on rocks, stones, or shells, from half-tide level to deep water. Some, as the *Coryne* and the *Campanulariadæ*, are more often found on sea-weeds. The

* See my observations on these organs in "The Devonshire Coast," *passim*.

Actiniadæ chiefly affect the rocks between tide-marks, but are not fixed, and the elegant *Lucernariæ* hang from slender sea-weeds. Our few native Madrepores (*Caryophyllacea*) are either natives of deep water, or are permanently fixed to rocks at the lowest tide-level, on the Devon and Cornwall coasts. The *Alcyonaria* are confined to deep water, except that small specimens of *Alcyonium* are occasionally found on rocks and under ledges within tide-marks.

Identification.—The points to be noticed are mainly these:—the cavity of the body, whether simple, or divided by radiating membranous plates; the increase, whether by buds from the sides, or by embryos discharged; if the latter, whether from the mouth, or from proper capsules; the presence or absence of a tube; the arrangement of the cells or buds in the compound tribes; the nature, texture, and arrangement of the solid skeleton; the number, form, and arrangement of the tentacles; the emission of poisoning threads; the adhesion or freedom of the base; and the general figure of the animal.

Authorities.—Dr. Johnston's "History of British Zoophytes," Mr. Dana's magnificent treatise "Zoophytes," in the American Exploring Expedition, and personal observation.

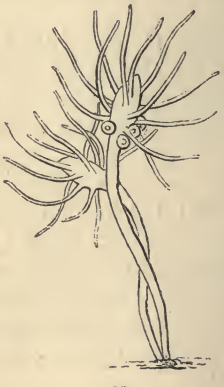
Zoophyta.

Animals of radiate structure, of gelatinous or fleshy substance, with a crown of tentacles surrounding the entrance to the stomach: furnished with offensive weapons in the form of capsules imbedded in the tissues, each of which incloses a

projectile poisoning dart: no special organs of sense: no distinction of sex.

Internal cavity simple; increasing by germs growing out from the sides . . . . . *Hydroïda.*

Internal cavity inclosing the stomach, and divided into compartments, by radiated partitions which have reproductive functions; germs ejected through the orifice of the cavity . . . *Actinoïda.*



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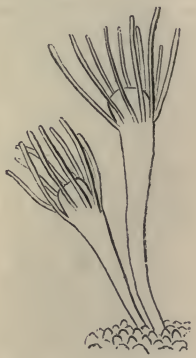


24

Order I. HYDROIDA.

Deciduous germs growing from near the base of tentacles, and naked; animals either naked, or inclosed in a horny, tubular envelope (*corallum*) . . . . . *Tubulariadæ.*

Egg-germs inclosed in vesicles; animals increasing by permanent lateral buds; inclosed in a horny envelope; polypes seated in cup-like cells.

Cells sessile . . . . . *Sertulariadæ.*
Cells on foot-stalks . . . . . *Campanulariadæ.*

Family I. Tubulariadæ.

Clava (Gmelin). Naked, fleshy; tentacles scattered, thread-like; mouth terminal, naked.

C. multicornis. Fig. 23; $\frac{1}{1}\frac{6}{}$.

Hydractinia (Van Beneden). Naked, fleshy, gregarious, many united on a common crust-like base; tentacles in one circle, thread-like; egg-germs sessile, clustered on untentacled individuals.

H. echinata. Fig. 24; $\frac{2}{1}\frac{0}{}$.
? littoralis.
? ——— ? (Johnston's Zooph. 2d Ed. p. 463.)

Myriothela (Sars) = *Spadix* (Gosse). Naked, solitary, club-shaped, extensile, crowded with short

25

26

27

wart-like tentacles: egg-germs globose, on branched foot-stalks, clustered around the base.

M. arctica. Fig. 25.

Coryne (Gaertner). Simple or branched; naked or inclosed in a rudimentary tube; tentacles having globular tips; mouth terminal, expansile, and capable of being used as a sucking disk; egg-germs simple, on short stalks.

C. pusilla.
ramosa.
sessilis. Fig. 26; $\frac{3}{1}$.
C. stauridia.
Cerberus.

Eudendrium (Ehr.). Inclosed. *Corallum* fibrous-rooted, erect, branching. Polypes protruding from the tips of the branches, not retractile, bearing a single circle of thread-like tentacles.

E. ramosum. Fig. 27; *n. s.* and *mag.*
? rameum.

Tubularia (Linn.). Inclosed. Corallum unbranching. Polypes bearing 2 circles of thread-like tentacles; egg-germs on short foot-stalks, clustered at the basis of the lower tentacles.

T. indivisa. Fig. 28.
Dumortierii.
larynx.
T. gracilis.
polyceps.

Corymorpha (Sars). Partially inclosed. Corallum short, thin, membranous, swollen at the base, which is plunged into the sand of the sea-bottom. Polype single, with the summit club-shaped; a circle of long thread-like tentacles around the base of the head, and a circle of short ones around the tip.

C. nutans. Fig. 29.
———— ? (Johnston's Zooph. 2d Ed. p. 463.)

28 29

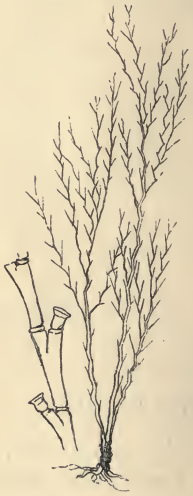
Family II. Sertulariadæ.

Halecium (Oken). Corallum plant-like; stem consisting of several tubes aggregated together; cells shallow cups, set on two opposite sides, alternately, one under every joint.

H. halecinum. Fig. 30; *n. s.* and *mag.*
Beanii.
muricatum.

Sertularia (Linn.). Corallum plant-like; stem simply tubular, branched, jointed; cells vase-like, with everted brims, alternate or in pairs, set on opposite sides.

S. polyzonias.
rugosa.
rosacea.
pumila.
Evansii.
nigra.
pinnata.
fusca.
pinaster.
S. margareta.
fallax.
tamarisca.
abietina. Fig. 31; *n. s.* and *mag.*
filicula.
operculata.
argentea.
cupressina.
gracilis.



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31

Reticularia (Wy. Thomps.). Corallum an investing network of horny tubes, immersed in a homogeneous horny crust; cells short projections of the tube, curved, with simple round orifices.

R. immersa. Fig. 31*; *mag.*

Coppinia (Hassall). Corallum parasitic, massive, hairy; cells lengthened, tubular, often curved,

arising at irregular distances (generally at the angles of junction) out of a cellular basis, the

31*

31**

apertures of the cells or spaces of which are often themselves covered in by a lid perforated by a small tubular orifice.

C. arcta. Fig. 31**; *mag.*

32

33

Thuiaria (Flem.). As *Sertularia*, but the cells are closely pressed to, or imbedded in, the surface of the stem or branches.

T. thuia. Fig. 32; *n. s.* and *mag.*
articulata.

Antennularia (Lamk.). Corallum simple or branched, jointed, with slender hair-like branchlets set in whorls; cells small cups set all on the inner side of the branchlets; egg-vesicles seated in the angles.

A. antennina. Fig. 33; *n. s.* and *mag.*
ramosa.

Plumularia (Lamk.). Corallum simple or branched, feathery; cells small, usually seated in the angles formed by horny spines on the inner side of the branches; egg-vesicles scattered.

* Stem simple.

P. falcata.
cristata.
pennatula.
pinnata. Fig. 34; *n. s.* and *mag.*
P. setacea.
Catharina
echinulata.
fascis.

** Stem composed of many parallel tubes.

P. myriophyllum.
P. frutescens.

Family III. Campanulariadæ.

Laomedea (Lamouroux). Corallum plant-like, erect, regularly jointed, the joints ringed, thickened, giving origin, alternately from opposite sides, to the cells, which are deep, goblet-shaped, and set at the end of short stalks. Egg-vesicles seated in the angles of the branches, each producing many embryos resembling medusæ.

L. dichotoma.
geniculata. Fig. 35; *n. s.* and *mag.*
gelatinosa.
L. obliqua.
Flemingii.
lacerata.

Campanularia (Lamk.). Corallum creeping, or erect; cells goblet-shaped, at the tips of long

ringed stalks set irregularly, or in whorls: egg-vesicles scattered, producing medusa-like embryos.

* Stem simple.

C. volubilis. Fig. 36; *n. s.* and *mag.* C. intertexta.
integra. syringa.
lacerata. parvula.
lævis. caliculata.
serpens.

** Stem of many parallel tubes.

C. verticillata. C. dumosa.

34

35

36

Order II. ACTINOIDA.

Tentacles 12 or upwards, rarely warty, perforate at the tip; radiating partitions of cavity, often depositing solid calcareous plates, which make a corallum . . . . . *Actinaria.*

Tentacles 8, warty or plumose, the branchlets perforate; often depositing a corallum, which is calcareous, or horny, rarely siliceous . . . . *Alcyonaria.*

Sub-Order I. ACTINARIA.

Tentacles many, in imperfect series, or scattered; corallum (when present) calcareous, cells many-rayed . . . . . *Astræacea.*

Tentacles many, in 2 or more series: mostly increasing by lateral buds; corallum (when present) calcareous, cells many-rayed . . . *Caryophyllacea.*

Tribe I. Astræacea.

With no corallum:—

Tentacles in uninterrupted circles . *Actiniadæ.*
Tentacles in remote groups . . . *Lucernariadæ.*

Family I. Actiniadæ.

Analysis of the Genera.

Adherent:—

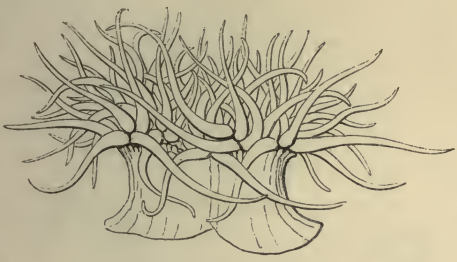
Tentacles scarcely retractile.
Adhering base entire . . . *Anthea.*
„ annular . . . *Adamsia.*
Tentacles readily retractile.
Tentacles knobbed . . . *Corynactis.*
„ truncate . . . *Capnea.*
„ conical.
Emitting filaments . . *Sagartia.*
Not emitting filaments.
Warted . . . *Bunodes.*
Smooth . . . *Actinia.*

Not adherent:—

Monotrematous.
Anterior extremity normal.
Tentacles equal . . . *Ilyanthus.*
„ unequal . . . *Arachnactis.*
Anterior extremity forming a retractile column . *Edwardsia.*
Ditrematous . . . . . *Peachia.*

Anthea (Johnst.). Body adherent, cylindrical; tentacles numerous, scarcely retractile within the body; their bases united in clusters.

A. cereus. Fig. 37.
Tuediæ.



37

Adamsia (Forbes). Body adherent to the mouths of univalve shells, gradually expanding laterally, till the two sides meet on the opposite lip of the shell, and unite with a suture: tentacles imperfectly retractile, short, surrounding a linear mouth.

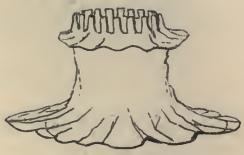
A. palliata. Fig. 38.

38

Corynactis (Allmann). Body adherent, not parasitic, cylindrical; tentacles retractile, each with an enlarged globose or two-lobed tip.

C. viridis.
Allmanni. Fig. 39.
heterocera.

39



40

Capnea (Forbes). Body cylindrical, invested in part by a lobed skin, adherent by a dilated base: tentacles retractile, short, truncate.

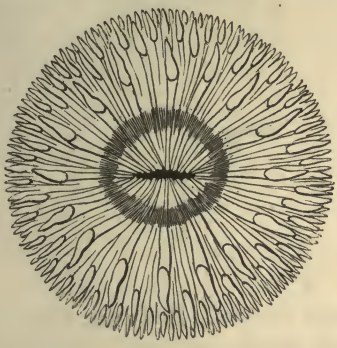
C. sanguinea. Fig. 40.

Sagartia (Gosse). Body adherent, cylindrical, without a skin; destitute of warts; emitting capsuliferous filaments from pores; nettling-threads short, densely armed with a brush of hairs; tentacles conical.

S. viduata (= anguicoma).
troglodytes.
aurora.
candida.
rosea.
S. nivea.
venusta.
parasitica.
bellis. Fig. 41.
dianthus.

Bunodes (Gosse). Body adherent, cylindrical, studded with warts; skin leathery; not emitting

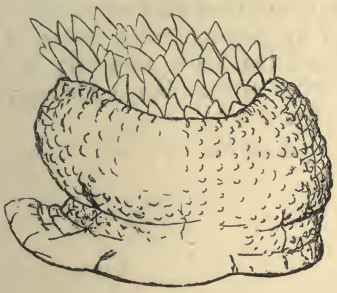
missile filaments; nettling-threads long and simple; tentacles generally thick, conical, obtuse.



41

B. gemmacea.
thallia.
clavata.
crassicornis. Fig. 42.

B. ? monile.
? chrysoplenum.
? alba.
? miniata.

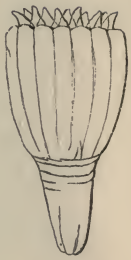


42

Actinia (Linn.). Body adherent, cylindrical; destitute of warts, of pores, and of missile filaments; skin smooth; a series of capsuliferous spherules at the margin of the disk.

A. mesembryanthemum. Fig. 43.
margaritifera.
chiococca.

43



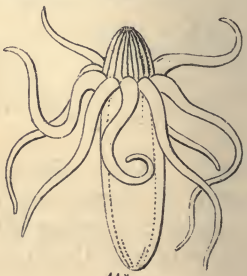
44

Ilyanthus (Forbes). Body not adherent, tapering to a point below; tentacles simple, retractile; anterior extremity normal; no posterior orifice.

I. Scoticus.
Mitchellii. Fig. 44.

Arachnactis (De Blainville). Body adherent or free at will, cylindrical with a rounded base; mouth surrounded by non-retractile tentacles (about 16) in two series, the outer ones very long, the inner short: it either swims like a Medusa, or adheres in deep water.

A. albida. Fig. 44*.



44*

Edwardsia (Quatrefages) = *Scolanthus* (Gosse). Body not adherent, worm-like; mouth and tentacles seated on a retractile column; hinder extremity inflated, membranous, retractile, not perforate.

E. callimorpha. Fig. 45.
sphæroides.

45

Peachia (Gosse). Body not adherent, sub-cylindrical, or pear-shaped, with a posterior orifice; tentacles few, short, thick, conical, set in one circle; oviduct terminating in a warted knob.

P. hastata. Fig. 46.
? chrysanthellum.

46

Family II. Lucernariadæ.

Lucernaria (Müller). Body bell or goblet shaped, adherent or free at pleasure; mouth quadrangular, in the centre of a membranous expanded disk; tentacles knobbed, clustered in groups on the projecting angles of the disk.

L. fascicularis.
auricula. Fig. 47.
campanulata.
cyathiformis.

47

48

49

Tribe II. Caryophyllacea.

Not depositing a corallum. Skin subcoriaceous. Tentacles short, marginal .	*Zoanthidæ.*
Depositing a corallum. Tentacles crowded. Mouth protrusile	*Caryophylleadæ.*

Family I. Zoanthidæ.

Zoanthus (Cuvier). Polypes compound, distant, arising from a common, creeping, root-like, fleshy band.

Z. Couchii. Fig. 48.

Family II. Caryophylleadæ.

Turbinalia (Lamk.). Corallum simple, inversely conical, furrowed on the outside, pointed below; the radiating plates hollowed into a cup-like cavity.

T. milletiana. Fig. 49.

Cyathina (Ehr.) = *Caryophyllea* (Johnst.). Corallum simple, or compound only by mutual adhesion, cylindrical, or inversely sub-conical, cup-like above, adherent: plates converging, graduated in three series; a sponge-like mass of contorted plates in the bottom of the cup. Animal actinia-like, with a ribbed mouth, and globose-tipped tentacles.

C. Smithii. Fig. 50; *n. s.*
borealis?

50

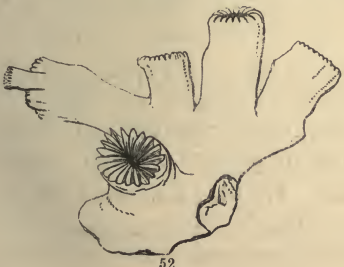
51

Balanophyllea (Wood). Corallum simple, cylindrical, adherent; plates arranged in threes which diverge from the circumference. Animal with a protrusile mouth, not ribbed, and conical tentacles.

B. regia. Fig. 51; *n. s.*

Oculina (Lamk.). Corallum branched in a tree-like manner, with long stems, solid, smooth.

O. prolifera. Fig. 52; *n. s.*



52

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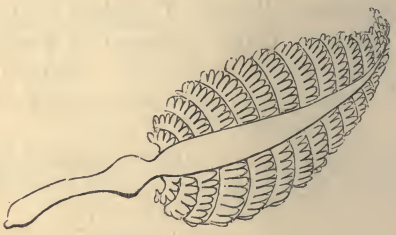
Sub-Order II. ALCYONARIA.

Free, or buried by the base in mud; never attached; feather-like.	*Pennatuladæ.*
Attached, fleshy, containing scattered calcareous spiculæ; form massive, irregular.	*Alcyoniidæ.*
Rooted, plant-like; forming basal epidermic secretions, and often also other secretions; the latter separable from the former	*Gorgoniadæ.*

Family I. Pennatuladæ.

Pennatula (Cuv.). Polype-mass feather-like, the shaft sub-cylindrical, naked beneath; pinnæ two-ranked, spreading, flattened, bearing the polypes on their upper margins.

P. phosphorea. Fig. 53; *n. s.*



53

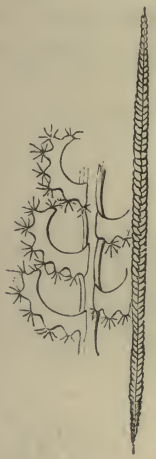
Virgularia (Lamk.). Polype-mass linear, lengthened, supporting, towards the upper end, sessile curving lobes, embracing the stem obliquely, and bearing a row of polypes on their margin.

V. mirabilis. Fig. 54, $\frac{1}{4}$ *n. s.*; and a few polypes, *n. s.*

Pavonaria (Cuv.). Polype-mass linear, lengthened, four-sided; polypes sessile, retractile, arranged

sub-spirally on one side only of the posterior half of the stem.

P. quadrangularis. Fig. 55, $\frac{1}{12}$ *n. s.*; and the tip, $\frac{1}{2}$ *n. s.*



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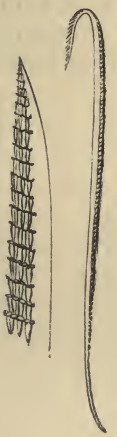


55

Family II. Alcyoniidæ.

Alcyonium (Linn.). Polype-mass lobed, incrusting submerged bodies, spongy, with star-like pores, from which protrude the polypes.

A. digitatum. Fig. 56, *n. s.*; and a polype, *mag.*
glomeratum.

Sarcodictyon (Forbes). Polype-mass incrusting, linear, creeping, uniting at intervals into a sort of network: polypes distant, in a single row of prominent cells.

S. catenata. Fig. 57; *n. s.*
agglomerata.

Family III. Gorgoniadæ.

Gorgonia (Linn.). Polype-mass consisting of a central axis, horny, flexible, continuous, branched; and an enveloping crust, soft and fleshy, in which the polypes are sunk.

G. verrucosa. Fig. 58; *n. s.*
pinnata.
anceps.

Primnoa (Lamk.). Central axis horny, becoming very hard, continuous: polype-cells protruded far beyond the crust, somewhat stalked, moveable, scaled, the aperture furnished with 8 shelly scales.

P. lepadifera. Fig. 59; *n. s.*

Class II. ACALEPHA.

(Sea-blubbers.)

The most common form of these animals is that of an umbrella, or a mushroom; a broad circular convex disk of jelly, usually clear and colourless, but sometimes having the frosted appearance of ground glass, and sometimes being tinged with delicate colours. From the under-surface or interior, called the sub-umbrella, commonly depends a fleshy mass called the *peduncle*, representing the handle of the umbrella, or the stem of the mushroom: sometimes this is slender and of considerable length, but more commonly it is thick, and so short as not to protrude below the level of the margin; it usually terminates in four expanding triangular lips, which are often much frilled and fringed at their edges. The centre of these four lips is the mouth, which leads to a cavity (the stomach) in the upper part of the peduncle, where the food is digested. Slender vessels radiate from this cavity, across the convexity of the "umbrella," to the circumference; where they open into another vessel, which runs completely round the margin. In all these vessels the nutritive fluid circulates from the stomach, as may be readily seen with a microscope, by the motion of the particles.

From the circumference generally proceed thread-like tentacles, varying in number and length, which are very sensitive, have great power of contraction, and are studded with capsules inclosing poison-threads, exactly resembling those of the Polypes, and serving the very same purpose, viz.

that of stunning and arresting active prey, which is then passed to the mouth and swallowed. The capsules are often crowded together at intervals, forming thickened rings around the tentacles, and their power is so great as to render some species truly formidable to man himself. The great *Cyanœa capillata* of our own seas, for example, is a species that stings most severely.

Around the margin also are placed the organs of sense. In one group called "Naked-eyed," there are bulbs or swellings at the bases of the tentacles, containing masses of coloured grains (*pigment cells*) usually bright red or black, which are believed to be rudimentary eyes. But in another group, the one called "Covered-eyed," the organs of vision are more complex, consisting of little columns inclosing a vast number of six-sided prisms of transparent substance, and protected by overhanging folds of membrane. In the former group there are also on the margin little globules of transparent membrane, inclosing one or more vibrating bodies, and believed to be organs of hearing.

The beauty of these creatures is very great; their elegant forms, their crystalline transparency, their beautiful tints, their brilliant eye-specks, the grace of their muslin-like frills and furbelows, their pulsatory movements,—all combine to make them, especially the smaller species, most attractive subjects of observation. Many of them exhibit in the dark the curious and interesting phenomenon of self-luminosity. On being touched or otherwise irritated, they suddenly become illuminated, the light appearing in rings or circles of luminous points, which alternately flash and die, like gas-jets on a festive gala-night.

But besides these common forms, which include nine-tenths of our native representatives of the Class, we have a few species of very different appearance. The most familiar of these are the *Beroes* and *Cydippes*, which look like tiny melons of glass, down whose bodies run bands or meridian-lines of paddles, which are the organs of locomotion. In the kinds above described, swimming is performed by alternate contractions and expansions of the whole disk; but in these it is effected by *cilia* set in short transverse rows, many of these rows making one meridian-band; these cilia-rows, moving up and down, strike the water with the most beautiful regularity, exactly like the paddles of a steamer, and row the little crystal globe along, with an even, graceful, gliding motion.

Others again, as the Portuguese man-of-war (*Physalia*), are floated by a large bladder filled with air, and are driven along the surface of the sea by the winds. Others, again, have their jelly-like flesh stretched over a plate of cartilage, as the Sallee-man (*Velella*), with a number of short tentacles dependent from the under-surface, while a diagonal plate stands up perpendicularly above, and acts as a sail. These kinds, however, are only accidental stragglers to our shores from warmer seas.

A very interesting point of connexion between this Class of animals and the preceding is the interchange of form. Some of the ZOOPHYTA, as the *Tubulariadæ* and the *Campanulariadæ*, give birth to a progeny which are, in every respect, Naked-eyed Medusæ; while, on the other hand, the young of the Medusæ are, in their earlier stages, stationary Polypes.*

* For many details of this "Alternation of Generations,"

Localities.—All the forms, at least in their adult condition, are free swimmers in the sea. They come to the surface in the finest, calmest weather, and most abundantly in the latter half of the day, and during the night, especially in summer and autumn. They must be caught by means of a muslin net drawn through the water, the bag of the net being at intervals turned inside out into a glass vessel of water, when the smaller specimens captured will float off uninjured. Many, however, are so transparent and so delicate, that they can with difficulty be detected.

Identification.—Attention must first be paid to the general form, whether umbrella-like, berry-like, or irregular. If the first, which will generally be the case, notice the eye-specks, whether exposed or covered by flaps; the number and condition of the radiating vessels, and the position and form of the ovaries. Finally, the shape of the umbrella, the form of the *peduncle*, the number and arrangement of the tentacles, the presence or absence of furbelows, and the number and position of the eyes, afford the distinctive marks of the genera.

Authorities.—For the general arrangement of the Class, I have followed the "System der Acalephen" of Eschscholtz, modified by Professor E. Forbes. For the enumeration of native species, I am indebted to the "Monograph of the Naked-eyed Medusæ" of the latter author, Dr. Gray's "Catalogue of British Radiata in the British Museum," and my own personal observations.

the reader is referred to Steenstrup's "Essay" (Ray Society), to Professor Forbes's "Monograph of the Naked-eyed Medusæ," and to my own "Devonshire Coast."

ACALEPHA.

Animals of radiate structure, of pellucid gelatinous substance, swimming freely in the sea, after they have attained their adult condition; with a digestive cavity, whence vessels diverge, carrying a circulating nutritive fluid; furnished with various organs of sense, and with poisoning weapons similar to those of the ZOOPHYTA: increasing generally by eggs; and subject to metamorphosis.

Body in form of a circular disk, more or less convex, and umbrella-like, with a great central digestive cavity; moving by alternate contractions and expansions of the disk.	*Discophora.*
Body symmetrical, not disk-shaped, with a great central digestive cavity; moving by means of many parallel rows of cilia, set in longitudinal lines on the surface. .	*Ctenophora.*
Body irregular; without a central cavity for digestion; with sucking organs; moving by means of a contractile cavity, or by vesicles filled with air	*Siphonophora.*

Order I. DISCOPHORA.

Eye-specks uncovered, or wanting; circulating vessels proceeding to the margin quite simple or branched. .	*Gymnophthalmata.*
Eye-specks protected by membranous hoods or lobed coverings; circulating vessels much ramified, and united into a network	*Steganophthalmata.*

Tribe I. Gymnophthalmata.

Vessels simple.

Vessels 4:

Ovaries in the substance of the peduncle . . . . . *Sarsiadæ.*

Ovaries along the vessels on the sub-umbrella. . . . . *Geryoniadæ.*

Ovaries convoluted, lining the stomach . . . . . *Oceaniadæ.*

Vessels 8:

Ovaries small, oval, placed on the vessels; disk tall, oblong. . . . . *Circeadæ.*

Vessels above 8:

Ovaries linear along the vessels; disk depressed . . . . *Æquoreadæ.*

Vessels branched . . . . . *Willsiadæ.*

Family I. Sarsiadæ.

Sarsia (Lesson). Umbrella hemispherical; ovaries not conspicuous; four marginal tentacles at the extremities of the vessels; eyes four; stomach in a very extensile cylindrical proboscis-like peduncle, with a simple orifice.

S. tubulosa. Fig. 60; *n. s.*
pulchella.
gemmifera.
prolifera.

Plancia (Forbes). Umbrella hemispherical; ovaries not conspicuous; two long marginal tentacles, and numerous intermediate tubercles, all furnished with eyes; stomach at the end of a very long extensile, cylindrical, tubular peduncle, with a simple or obscurely-lobed orifice.

P. gracilis. Fig. 60*; *n. s.*

Bougainvillæa (Less.). Umbrella spherical; ovaries as four equal lobes, on the sides of the short peduncle; tentacles arranged in four marginal groups; peduncle terminating in four ramifying tentacled lips.

B. Britannica. Fig. 61; *n. s.*
nigritella.
pyramidata.
B. crucifera.
simplex.

Lizzia (Forbes). Umb. oblong; ovaries as four lobes on the sides of the short peduncle; tentacles in eight unequal groups.

L. octopunctata. Fig. 62; *n. s.*
blondina.

Modeeria (Forbes). Umb. globose; tentacles four; eyes conspicuous; peduncle balloon-shaped, four-lipped.

M. formosa. Fig. 63; *n. s.*

Euphysa (Forbes). Umb. globose; peduncle flask-like with a proboscis-like mouth, and the ovaries at its base; four conspicuous coloured eyes, from each of which arises a short filament, and from one a single thick tentacle.

E. aurata. Fig. 64; *n. s.*

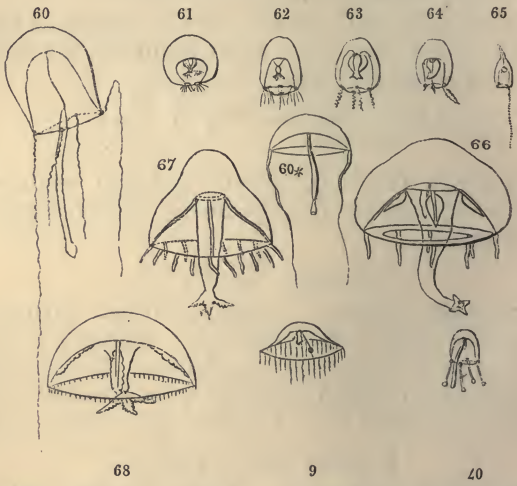
Steenstrupia (Forbes). Umb. conical, with a produced apex, connected by a cord with the subumbrella; four marginal glands, with a long tentacle depending from one of them only: peduncle proboscis-like.

S. rubra.
flaveola. Fig. 65; *n. s.*

Family II. Geryoniadæ.

Geryonia (Péron). Umb. hemispherical; tentacles variable (8 in the British species); ovaries leaf-like; peduncle long, inversely conical, with four lips.

G. appendiculata. Fig. 66; *n. s.*



Tima (Esch.). Umb. hemispherical; tentacles numerous (16); ovaries linear; peduncle cylindrical, four-lipped.

T. Bairdii. Fig. 67; $\frac{1}{3}$.

Geryonopsis (Forbes). Umb. hemispherical; ovaries club-shaped; tentacles numerous (68), very short; peduncle short, with four large radiating fringed lips.

G. delicatula. Fig. 68; $\frac{1}{1}$.

Thaumantias (Esch.). Umb. variable; ovaries ovate or linear; tentacles 4 to 200; always with coloured bulbs; peduncle short, with four, rarely fringed, lips.

* Tentacles of two kinds.

T. pilosella.

** Tentacles of one kind only.

α Tentacles four.

T. quadrata. T. aeronautica.

β Tentacles eight.

T. octona.

γ Tentacles sixteen and upwards.

T. maculata.
melanops.
globosa.
convexa.
gibbosa.
lineata.
pileata.
Sarnica.
Thompsoni.

T. hemisphærica.
inconspicua.
punctata.
lucifera.
Buskiana. Fig. 69; *n. s.*
corynetes.
undulata.
confluens.

Slabberia (Forbes). Umb. bell-shaped; ovaries linear; peduncle proboscis-like, very extensile; four tentacles with knobbed tips.

S. halterata. Fig. 70; *n. s.*
catenata.

Family III. Oceaniadæ.

Turris (Less.). Umb. mitre-shaped, with conspicuous muscles; ovaries double, dense; tentacles numerous; peduncle globose, with fringed lips.

T. digitalis.
neglecta. Fig. 71; *n. s.*

Saphenia (Esch.). Umb. mitre-shaped; ovaries double; peduncle very extensile, four-lipped; tentacles two, large, opposite, and a great number of intermediate minute ones.

S. dinema.
Titania. Fig. 72; $\frac{4}{1}$.

71 72 73 74

Oceania (Péron). Umb. mitre-shaped, or globular; tentacles similar, varying in number; no conspicuous muscles; peduncle four-lipped.

O. octona.
episcopalis.
ducalis.

O. turrita.
globulosa.
pusilla. Fig. 73; $\frac{2}{1}$.

Family IV. Circeadæ.

Circe (Mert.). Umb. mitre-shaped, tall; ovaries set around its roof; tentacles numerous; peduncle cylindrical, with four lips.

C. rosea. Fig. 74; *n. s.*

Family V. Æquoreadæ.

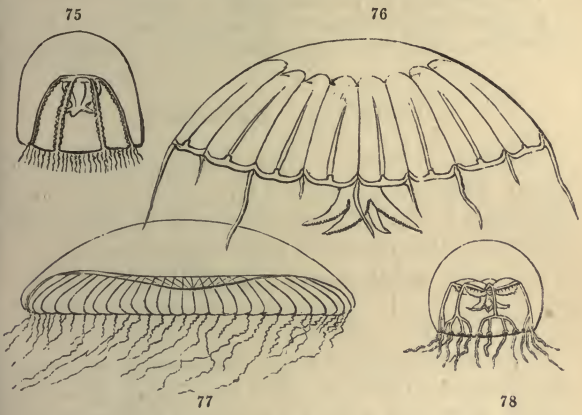
Stomobrachium (Brandt). Umb. convex; tentacles numerous; peduncle short, with lobed and fringed lips.

S. octocostatum. Fig. 75; *n. s.*

Polyxenia (Esch.). Umb. depressed; ovaries numerous (16), set in the centres of triangular

spaces, reaching nearly to the margin; tentacles 16, alternating with the vessels; peduncle short, terminating in four long lips.

P. Alderi. Fig. 76; *n. s.*



Æquorea (Péron). Umb. depressed, convex; vessels and ovaries very numerous; peduncle wide, expanding into many broad long-fringed lobes; tentacles varying in number, slender.

Æ. Forskallii.
vitrina.
Forbesiana. Fig. 77; $\frac{1}{2}$.

Family VI. Willsiadæ.

Willsia (Forbes). Umb. globose; ovaries 6; vessels 6, twice dichotomously dividing, as they approach the margin; an eye and a tentacle opposite each branch; peduncle short, four-lipped.

W. stellata. Fig. 78; $\frac{2}{1}$.

Tribe II. Steganophthalmata.

Stomach furnished with a mouth, through which solid food is received . . . . . *Medusadæ.*
Stomach with no central orifice or mouth, but absorbing nourishment through the extremities of long ramifying canals . . . . *Rhizostomadæ.*

Family I. Medusadæ.

Medusa (Linn.). Umb. hemispherical, with many marginal tentacles; having 8 eyes covered by lobes, 4 ovaries, 4 chambers, 4 fringed arms; a central opening and 4 lateral openings.

M. aurita. Fig. 79; $\frac{1}{4}$.
campanula.
Surirea.

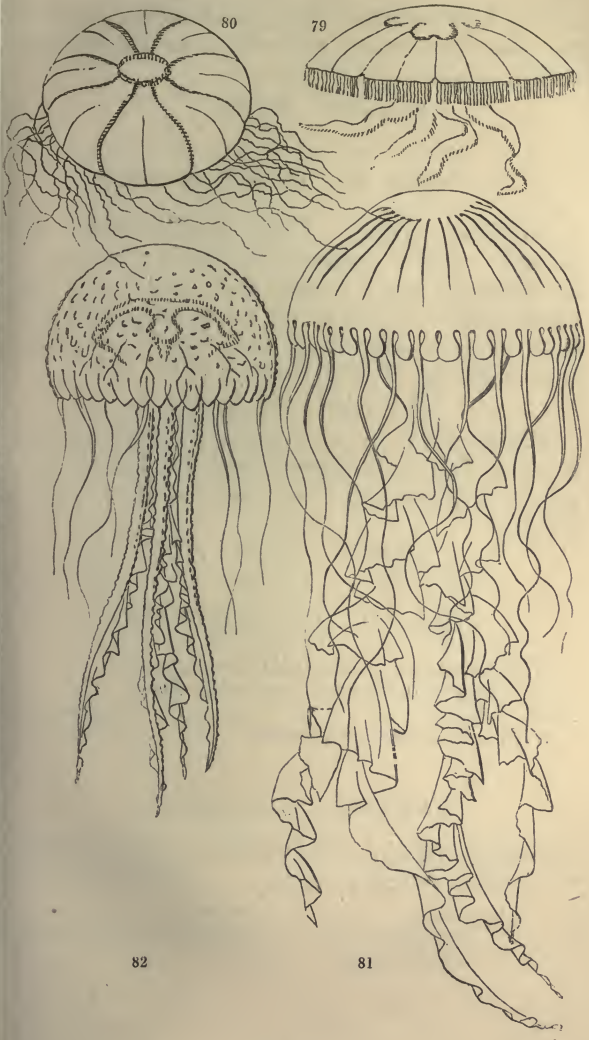
Cyanœa (Péron). Umb. depressed, scolloped; appendages to the stomach in form of sacs alternately large and small; 4 openings; peduncle perforated in the centre; 4 fringed arms; marginal tentacles very numerous, inserted beneath the disk.

C. capillata. Fig. 80; $\frac{1}{15}$.
Lamarckii.

Chrysaora (Pér.). Umb. hemispherical, festooned; marginal tentacles more than 8; appendages to the stomach sac-like, opening by a single orifice in the centre of the peduncle; 4 very long, furbelowed, unfringed arms.

C. hyoscella.
cyclonota. Fig. 81; $\frac{1}{2}$.

Pelagia (Pér.). Umb. sub-hemispherical or globose, scolloped; marginal tentacles 8; peduncle


80
79
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81

ending in 4 leaf-like, furbelowed arms, united at the base; 4 ovaries; appendages to the stomach without orifices.

P. cyanella. Fig. 82; $\frac{2}{3}$.

Family II. Rhizostomadæ.

Cassiopea (Pér.). Umb. hemispherical, depressed, without marginal tentacles; ovaries 8; no peduncle, but a central disk, with 4 or 8 half-moon-shaped orifices at its sides, and sending off 8 or 10 much-branching arms, which are fringed with retractile, stalked, sucking disks.

C. lunulata. Fig. 83; $\frac{1}{14}$.

Rhizostoma (Cuv.). Ovaries 4; peduncle with 4 or 8 half-moon-shaped orifices, formed by 4 pillars dividing into 8 cartilaginous arms, without fringes.

R. pulmo. Fig. 84; $\frac{1}{12}$.

Order II. CTENOPHORA.

With a chamber on each side, containing a long, very extensile and contractile filament . . . . . *Callianiradæ.*
With no chambers or filaments . . . *Beroidæ.*

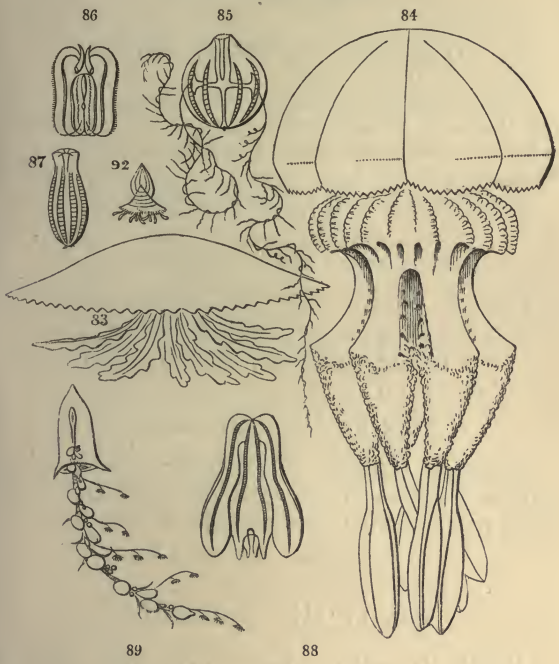
Family I. Callianiradæ.

Cydippe (Esch.). Body globose; with no swimming-lobes or oral tentacles.

C. pileus.
Flemingii.
infundibulum.
C. lagena.
pomiformis. Fig. 85; *n. s.*

Bolina (Patterson). Body compressed; with 4 wimming-lobes.

B. hibernica. Fig. 86.



Family II. Beroidæ.

Beroe (Müller). Body ovate; with no filaments, lobes or tentacles.

B. cucumis.
fulgens. Fig. 87; *n. s.*
borealis.

Alcinoe (Cuv.). Body furnished with swimming lobes and oral tentacles: (fig. 88).*

A. rotunda.
Smithii.

Order III. SIPHONOPHORA.

Animals double, bell-shaped; one fitting into the cavity of the other . . . . . *Diphyidæ.*
Animal consisting of a large air-vessel, with numerous tentacles . . . . . *Physaliadæ.*
Animal stretched over a cartilaginous plate. *Velelladæ.*

Family I. Diphyidæ.

Diphyes (Cuv.). Animals similar, pyramidal, with a few points around the aperture.

D. campanulifera (?) Fig. 89; *mag.* $\frac{6}{1}$.

Family II. Physaliadæ.

Physalia (Lamk.). Air-vessel large, oblong, with a wrinkled crest; tentacles of several forms, long, pendent from near one end of the vessel.

P. pelagica. Fig. 90; $\frac{1}{4}$ *n. s.*

Family III. Velelladæ.

Velella (Lamk.). Body oval, flat, with an oblique vertical cartilaginous crest above, and a central tubular mouth below, surrounded by numerous short tentacles.

V. vulgaris. Fig. 91; *n. s.*

* The figure (88) represents *A. vermiculata*, found in the South Atlantic. I am not aware that any published figure of either of our native species exists.

90

91

Rataria (Esch.). Body circular, with a compressed, elevated, cartilaginous piece within, which has a moveable muscular crest; below concave, with a tubular mouth, surrounded by tentacles in a single marginal row.

R. pocillum. Fig. 92; *n. s.*

Class III. ECHINODERMATA.

This word, which signifies "hedgehog-skinned," sufficiently expresses the character that is most conspicuous in these animals, and which is so generally prevalent as to serve in most cases for their identification. They are clothed with prickles; and these are either conical, sharp-pointed warts, which are immoveable, studding the leathery skin, or they are symmetrical spines variously shaped and sculptured, usually jointed upon the surface of shelly plates, so as to be capable of motion to a certain limited extent.

The form of the animals of this group is also characteristic; though it varies much in appearance, a moment's observation shows that there is a common principle in the whole, which reduces all the varieties to modifications of one model. That model is a star with five radiating points or rays, such as we see in the most simple condition in the Sand-star (*Ophiura*), a central body round and flat, with five long taper rays set around the edge, like the tails of snakes, diverging in as many directions. Sometimes these rays consist each of two filaments springing from the same base, and then we have a *Comatula;* or the ray may divide, and subdivide, and subdivide again, to a high degree of ramification, until the terminations are immensely numerous and of hair-like fineness,—and thus we have a Medusa's Head (*Astrophyton*). The rays may become so broad at the base as to merge into one another, and we have the common Star-fish (*Uraster*); they may be more numerous than five,

and we have the Sun-stars (*Solaster*); the angles may be gradually filled up, the rays becoming shorter and shorter, as in the Starlets (*Goniaster*, &c.); and at length they may be quite lost as rays, appearing only as the five angles of a disk, and then we have the Bird's-foot (*Palmipes*).

The starry form has now quite disappeared, but changes still proceed in the same direction; the body, from being flexible, becomes invested with strong plates clothed with moveable spines, and the five-angled outline is more and more lost. It is still discernible in the Cake-urchin (*Echinarachnius*); but in the true Urchins or Sea-eggs (*Echinus*), the form is become almost globular, and the chief traces of the quinary arrangement are in the rows of minute holes, which radiate, *in five pairs* of lines, from one pole to the other of the globe.

Again the texture of the skin changes; it becomes soft and fleshy; the globose figure becomes columnar, at first short and thick, but gradually increasing in length until we find the Class passing out of our view in forms which it is hard to distinguish from true Worms. For a while, as in the Sea-cucumbers (*Pentactidæ*), suckers run down the body in five double rows; but in the *Thyonidæ* this arrangement is lost; and finally, in the *Synaptadæ*, all traces of this fivefold radiism disappear.

I have just spoken of suckers; these are singular organs, and highly characteristic of the ECHINODERMATA. In the earlier families they are not found; and locomotion is performed chiefly by the flexibility and prehensile character of the lithe and slender rays. But in the Starfishes, Sea-urchins,

and Sea-cucumbers, suckers are the proper organs of motion. If we put an Urchin into a glass of sea-water, we presently perceive a multitude of slender, pellucid, fleshy threads pushed out from its surface, each tipped with a little knob. We see these waving to and fro, until one after another comes in contact with the glass, to which the knob adheres, as a dilated circular plate; and that with such force that the animal is able, by the common power of many of these "sucker-feet," slowly to drag itself along, others being ready every instant to take fresh hold, and assist the pulling, in the course of the progression. Under the microscope the tip is found to be occupied by a round calcareous plate; and the muscular flesh which surrounds it being pressed close to the surface of the glass, a vacuum is formed, on the principle of a cupping-glass, which resists considerable force, until the creature relaxes its muscular contraction. When they are no longer wanted in action, they are withdrawn and disappear; and if we examine the animal in a dry state, after rubbing off the investing spines, we shall see what has become of them: they were withdrawn, at least with the exception of the terminal knob, into the interior of the shell, through those minute holes which I just now spoke of as running in five double series down the sides of the animal.

According to Professor Forbes there are, in a moderate-sized Urchin, sixty-two rows of pores in each of the ten series or "avenues;" and as there are three pairs of pores in each row, the total number of pores is 3,720; but as each sucker occupies a pair of pores, the number of suckers is 1860.*

* "British Starfishes," p. 152.

In such species as these, where the vital parts are inclosed in a box of hard shelly substance, there is a beautiful provision for progressive growth. The shell is composed of a multitude of plates (nearly 600 in all) of regular angular forms, all dove-tailed together with the greatest nicety, each enveloped in a very thin layer of living flesh which secretes and deposits calcareous matter. Now, if the shell had been made in one piece, formed as it is by the deposition of lime from the surface of the animal, it is manifest that every layer deposited would have diminished the interior, while the growing animal would ever be requiring more room. But as it is, every one of these angular plates is increased by layers on its inner surface, each layer being a little wider than the preceding; and thus each piece gradually enlarges, (and therefore the bulk of the whole shell also,) while at the same time the definite form of every one is accurately maintained. These 600 plates bear on their surface above 4,000 spines, each an exquisite structure, formed of minute chambers separated by thin calcareous walls, transparent as glass, often beautifully fluted or otherwise sculptured, with a ball and socket-joint at its base, and muscles which give it motion. Well may the eloquent historian of the British Starfishes observe, that "the skill of the Great Architect of Nature is not less displayed in the construction of a Sea-urchin than in the building up of a world!" *

Among the spines and suckers of a Sea-urchin we discover a multitude of other objects endowed with vigorous motion, and highly curious in their nature. For a long time it was a matter of un-

* "British Starfishes," p. 153.

certainty whether these were peculiar organs of the Urchin, or parasitic animals that lived upon its body: the former is now, however, ascertained to be the true state of the case. These organs, which are termed *pedicellariæ*, are diverse in shape; but in general they may be described as consisting of a thick head, cleft into three divisions, and set on a long, slender, flexible stalk. Through a portion only of the stalk passes an inflexible shelly support, like a bone; but there is left a considerable part which is perfectly soft, flexible, and highly contractile; and by the motions of this part, the massive head is thrown about in all directions with great vivacity. In the common Urchin (*Echinus sphæra*), the largest sort of *pedicellaria* has a head shaped something like a sugar-loaf, split from the apex to the base into three lobes, which gape widely, and close together with most ferocious snappings. These openings and shuttings of the threefold jaws are constantly going on, fitfully, and without any regularity or agreement; and most interesting it is to watch them, and to endeavour to discover what possible end is accomplished by the procedure.

If we examine these bodies with high microscopic powers, little light is afforded on the question of their special functions, though it is thus that they are determined to be organic appendages of the *Echinus*. But new admiration is excited at their elaborate structure and finish. The head consists principally of calcareous substance, which, as well as the supporting column of the stalk, is penetrated with isolated cells throughout. The bases of the three-lobed heads are articulated in the most remarkable manner; and the lobes themselves, which are sometimes attenuated to three slender

pins, are cut along their meeting edges, into minute teeth, which fit and lock into each other with exquisite precision. The whole body and head are invested with a gelatinous flesh, in which are imbedded minute red glands, that are common to the integument of the whole Class, and this is covered with a series of vibratile cilia.

What may be the use of these very curious organs in the economy of the animal, is as yet unknown. Their prehensile power is obvious; but whether this is exercised in the way of defensive weapons, or as hands to catch food and pass it to the mouth, is among the things that we have yet to learn.

All the ECHINODERMATA pass through a sort of metamorphosis, not less wonderful than other passages of their history. Until lately we knew nothing of the early life of these animals; but Johann Müller has, with great skill, industry, and success, solved this problem. The first condition of every Echinoderm is the same; an egg-like body, covered with cilia, resembling an *Infusorium*. Changes take place, and we presently see another form assumed, which varies in some degree in the different families. I lately had the pleasure of finding in my dip-net several little larvæ of an *Ophiocoma;* and the aspect of one of these may serve to illustrate the subject.

A painter's long easel affords the only object with which to compare the little creature; for it consists of four long, slender, calcareous rods, arranged two in front and two behind, with connecting pieces going across in a peculiar manner, and meeting at the top in a slender head.

On this shelly, fragile, and most delicate framework, as on a skeleton, are placed the soft parts of

the animal, a clear gelatinous flesh, forming a sort of semi-oval tunic around it, from the summit to the middle; but thence downward the rods individually are merely encased in the flesh, without mutual connexion. The interior of the body displays a large cavity, into which a sort of mouth ever and anon admits a gulp of water. Delicate cilia cover the whole integument, and are particularly large and strong on the flesh of the projecting rods.

The appearance of this most singular animal is very beautiful; its colour pellucid-white, except the summit of the apical knob, and the extremities of the greater rods, which are of a lovely rose-colour. It swims in an upright position, with a calm and deliberate progression. The specimens which I have seen were not more than one-fortieth of an inch in length.

From this form the Brittle-star is developed, but in a manner unparalleled in any other class of animals. The exterior figure is not gradually changed, but the star is constructed within a particular part of the body of the larva, "like a picture upon its canvas, or a piece of embroidery in its frame, and then takes up into itself the digestive organs of the larva." The plane of the future Star-fish is not even the plane of the larva, but one quite independent of, and oblique to it. Strange to tell, the young Star does not absorb into itself the body of the larva, which has acted as a nidus for it, but throws it off as so much useless lumber;—flesh, rods, and all!*

Localities.—The majority of the Class affect

* See Müller, in Trans. Berl. Acad., 1846—1852, and his Archiv, for 1850 and 1851.

rocky shores. The Sand-stars (*Ophiura*), the Long-armed Brittle-star (*Ophiocoma filiformis*), and some of the worm-like forms among the *Sipunculidæ*, resort to sandy bottoms. The Starlet (*Asterina*) delights in those weed-fringed pools that afford such a copious source of entertainment to the naturalist. Several of the small species of Brittle-star (*Ophiocoma neglecta*, *O. Ballii*, &c.) are frequently found under stones at low water, together with several kinds of the *Pentactidæ*, and the Purple-tipped Urchin (*Echinus miliaris*). The Purple Urchin (*E. lividus*) excavates hollows for itself in limestone rock, in which it resides; this species is confined to Ireland. The Heart-urchins (*Spatangidæ*) chiefly resort to a bottom of mud or silt, in rather deep water. The *Sipunculi* inhabit old shells of univalve *Mollusca*, and several of the kindred kinds dwell in narrow crevices of rocks. But the great majority of the species are brought up by the dredge from a hard bottom; and the most prolific of all localities are those banks on which oysters and scallops breed, and the places frequented by trawlers, where the refuse of the trawl has been thrown overboard for ages. Such situations never fail to afford the richest harvests to the dredger.

Authorities.—Professor E. Forbes's "History of British Starfishes" is the classic work on our native species; very few having been discovered since the publication of that volume. I have slightly deviated from him in the general arrangement, in this respect following Dr. Gray's order suggested in the Synopsis of the British Museum, 1841.

ECHINODERMATA.

Animals having a radiate structure, covered with a more or less leathery coat, in which are imbedded variously-shaped calcareous pieces, sometimes minute and few, sometimes so numerous as to form a shelly box, composed of plates moveable or tightly bound together, and increasing by the deposition of particles around the margin of each individual plate. The radiation is characterised by the number five.

With a bag-like stomach, furnished with only one aperture; the body lobed, or expanding into rays	*Hypostomata.*
With a distinct digestive canal, furnished with a mouth and vent: outline of body entire	*Ditremata.*

SUB-CLASS I. HYPOSTOMATA.

Digestive canal unsymmetrical; calcareous shell composed of moveable pieces, forming an external skeleton	*Crinoidea.*
Digestive canal symmetrical; calcareous shell, composed of moveable pieces, forming an internal skeleton, with a covering sometimes leathery, and sometimes calcareous .	*Asteroidea.*

Order I. CRINOIDEA.

Comatula (Lamk.). Body with 5 forked pinnate rays. When young, seated on a long simple jointed attached stem. When adult, free, stemless, with

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simple thread-like jointed appendages around the dorsal disk.

C. rosacea. Fig. 93; $\frac{1}{2}$ *n. s.*

93

Order II. ASTEROIDEA.

With long snake-like rays, appended to round depressed urchin-like disks; locomotion performed by spines, and not by suckers . . . . *Ophiuradæ.*
With angles or rays which are not appendages, but parts of the body; locomotion by suckers protruded from beneath the rays . . . . . *Asteriadæ.*

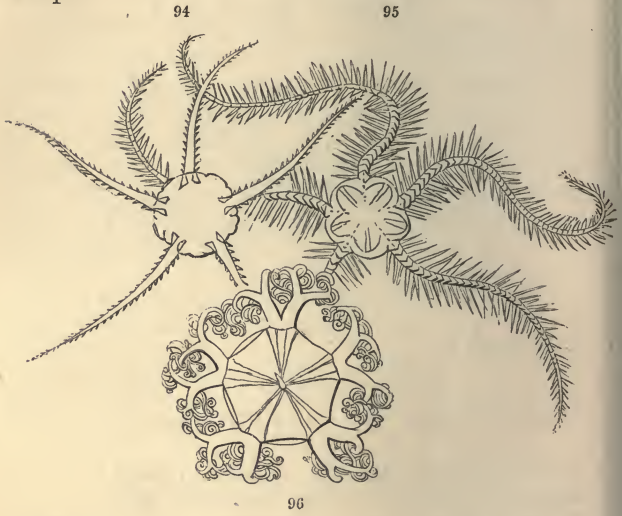
Family I. Ophiuradæ.

With the rays simple . . . . . *Ophiurana.*
With the rays much ramified . . . . . *Euryalina.*

Sub-Family I. Ophiurana.

Ophiura (Lamk.). Rays simple, scaly, prolonged into the disk above, and separated at their

origins beneath by large shield-shaped plates: cirri (or flexible threads between the ray-spines) simple.



O. texturata.
albida. Fig. 94; *n. s.*

Ophiocoma (Agassiz). Rays simple, scaly, not prolonged into the disk above; and separated at their origins beneath by small five-sided plates: cirri pinnate.

*

O. neglecta.
punctata.

O. filiformis.

* *

O. bellis.
brachiata.
parmularia.

O. Ballii.
Goodsiri.

* * *

O. granulata.

* * * *

O. rosula. Fig. 95; *n. s.* O. minuta.

Sub-Family II. Euryalina.

Astrophyton (Link). Rays round, dividing from the base, and repeatedly branching, so as to terminate in very numerous fine filaments.

A. scutatum. Fig. 96; $\frac{1}{3}$.

Family II. Asteriadæ.

Body slightly conical, with rounded rays:	
4 ranges of suckers in each avenue . .	*Urasterina.*
2 ranges of suckers in each avenue . .	*Solasterina.*
Body distinctly conical, five-angled, with 2 ranges of suckers	*Goniasterina.*
Body flat, with short rays; 2 ranges of suckers	*Asteriana.*

Sub-Family I. Urasterina.

Uraster (Agass.). Rays few, spinous; avenues bordered by three sets of spines.

U. glacialis. U. violacea.
rubens. Fig. 97; $\frac{1}{10}$. hispida.

Sub-Family II. Solasterina.

Cribella (Agass.). Rays few, covered (as is the disk) with spine-bearing warts; intermediate spaces porous; avenues bordered by two sets of spines.

C. oculata. Fig. 98; $\frac{1}{4}$. C. rosea.

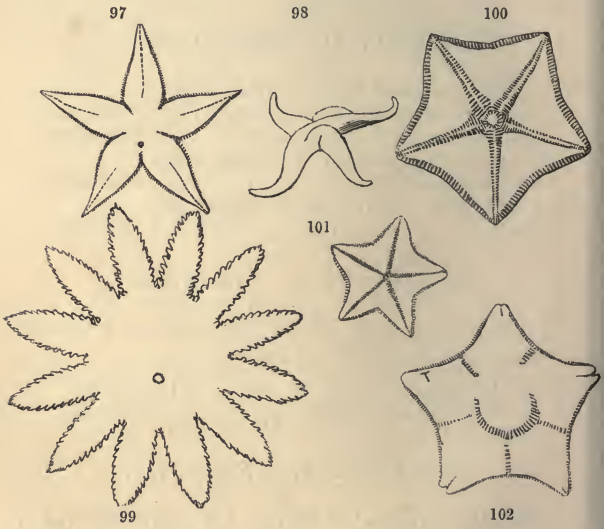
Solaster (Forbes). Rays many, studded with bundles of spines; avenues bordered by three sets of spines.

S. endeca. S. papposa. Fig. 99; ¼.

Sub-Family III. Goniasterina.

Palmipes (Link). Body nearly flat, thin, covered with little bundles of spines; avenues bordered by longitudinal bundles of spines.

P. membranaceus. Fig. 100; ⅓.



Asterina (Nardo). Body thick, covered above and below with short spines; avenues bordered by a single row of spines.

A. gibbosa. Fig. 101; *under surface;* ⅔.

Goniaster (Agass.). Body thick, bordered by a series of plates edged with spines; avenues bordered by transverse rows of spines.

G. Templetoni. Fig. 102; $\frac{1}{2}$. G. equestris. Abbensis.

Sub-Family IV. Asteriana.

Asterias (Linn.). Body star-shaped; rays flat, with a border of marginal plates; avenues bordered by three sets of spines.

A. aurantiaca. Fig. 103; $\frac{1}{4}$.

103

104

Luidia (Forbes). Body star-shaped, many-rayed; rays flat, covered above with spine-bearing warts; avenues bordered by two sets of spines.

L. fragilissima. Fig. 104; $\frac{1}{24}$.

Sub-Class II. Ditremata.

Shell calcareous, forming a spherical or disk-like shield, composed of immoveable plates; locomotion by suckers and spines.	*Echinoidea.*
No shell; but the leathery skin containing calcareous reticulated pieces: gullet surrounded by a calcareous ring; body cylindrical; locomotion usually by suckers; mouth encircled by feathery tentacles.	*Holothuroidea.*

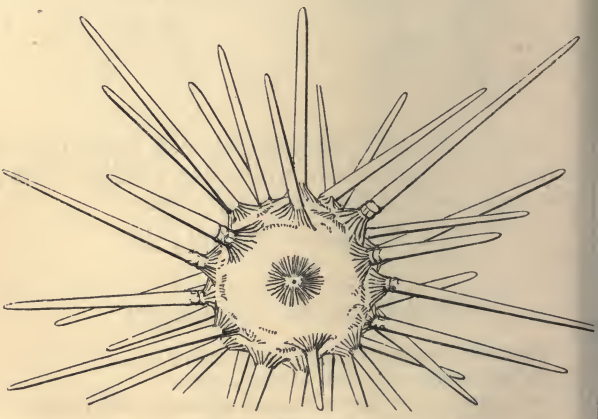
No shell; nor any calcareous pieces in the leathery skin; no calcareous ring around the gullet; body cylindrical; locomotion by alternate contraction and extension of the body . . . . . *Sipunculoidea.*

Order I. ECHINOIDEA.

Mouth below; vent above; both central; avenues 5, continuous from the vent to the mouth; ovaries 5; a complex apparatus of teeth . . . . . *Cidaridæ.*

Mouth and vent below; the mouth central, armed with teeth; avenues not continuous; ovaries 5 . . . . . *Clypeasteridæ.*

Mouth below, not central; vent at one side; avenues not continuous; ovaries 4; no teeth . . . . . *Spatangidæ.*



105

Family I. Cidaridæ.

Cidaris (Leske). Body globose; vent and

mouth nearly equal; spines of several forms, moving on rounded knobs, which are perforated.

C. papillata. Fig. 105; *n. s.*

Echinus (Linn.). As *Cidaris;* but the spines are of one form, and their knobs are not perforated.

*

E. sphæra. Fig. 106; ½.
miliaris.
Flemingii.

E. lividus.
melo.

* *

E. neglectus.

E. Norvegicus.

Family II. Clypeasteridæ.

Echinocyamus (Leske). Body oval, with rounded sides; avenues dorsal, short; vent between the mouth, and the hinder margin.

E. pusillus. Fig. 107; *n. s.*

Echinarachnius (Leske). Body nearly circular, very flat, with the margin nearly sharp and entire; avenues five, dorsal, short; vent above, close to the edge.

E. placenta. Fig. 108; ¼.

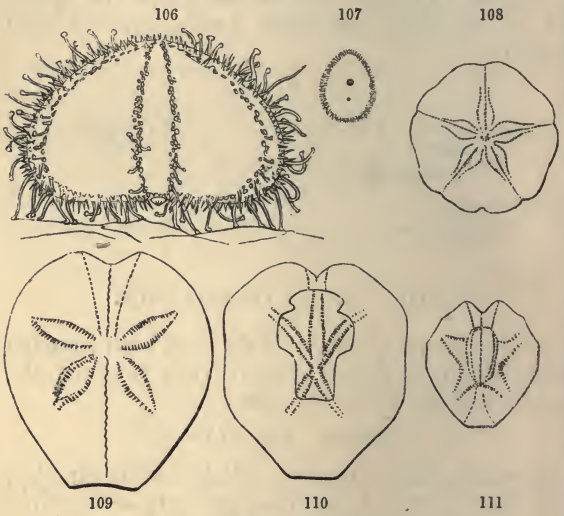
Family III. Spatangidæ.

Spatangus (Klein). Body heart-shaped, flattish; with avenues both above and below; four of the upper ones leaf-shaped; no dorsal impression; impression under the vent transverse.

S. purpureus. Fig. 109; ¼.

Brissus (Klein). Body heart-shaped, convex; avenues as in *Spatangus;* a dorsal impression enclosing the upper avenues.

B. lyrifer. Fig. 110; $\frac{1}{2}$.



Amphidotus (Agass.). Body heart-shaped, convex; four of the dorsal avenues truncate, oblong, with an impression within them; impression under the vent oval or heart-shaped.

A. cordatus. Fig. 111; $\frac{1}{2}$. A. roseus.

Order II. HOLOTHUROIDEA.

Suckers arranged in five regular rows; body angular	*Pentactadæ.*
Suckers scattered over the whole surface; body cylindrical	*Thyonidæ.*

Three rows of suckers placed on an oblong crawling disk; the other two rows rudimentary	*Psolidæ.*
No suckers	*Synaptadæ.*

Family I. Pentactadæ.

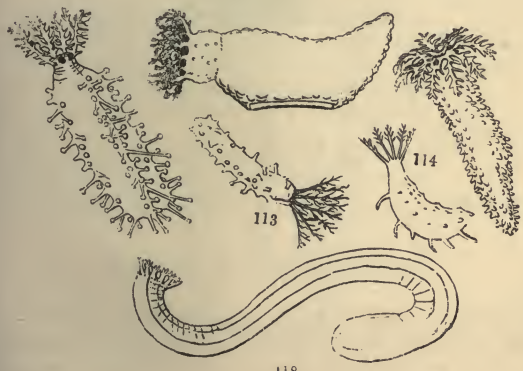
Pentacta (Agass.). Suckers alternate in each row, close-set; tentacles ten; dental apparatus composed of nearly square plates; no gizzard.

P. frondosa.
pentactes. Fig. 112; ½.
communis.
fusiformis.
hyalina.
Drummondii.
P. Hyndmanni.
fucicola.
Montagui.
Neillii.
dissimilis.

Ocnus (Forbes). Body regular, five-sided, with five rows of distant suckers on the angles; tentacles ten; dental apparatus very short; a gizzard.

O. brunneus. Fig. 113; *n. s.* O. lacteus.

112 117 115



Psolinus (Forbes). Body irregular, ovate, curved, with five rows of distant suckers, the under ones always bent; tentacles ten; dental apparatus short, truncate; no gizzard.

P. brevis. Fig. 114; $\frac{2}{1}$.

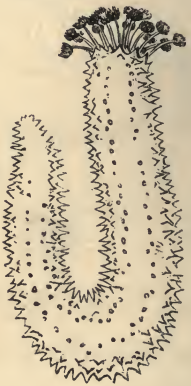
Family II. Thyonidæ.

Thyone (Oken). Body nearly regular, covered with scattered wart-like suckers; tentacles ten; teeth long and thread-like.

T. papillosa. Fig. 115; *n. s.* T. Portlockii.
raphanus.

Holothuria (Linn.). Body lengthened, soft, nearly cylindrical, covered with scattered suckers; tentacles twenty; vent widely open.

H. nigra. Fig. 116; $\frac{1}{3}$.
intestinalis.
tubulosa.



116

Family III. Psolidæ.

Psolus (Oken). Body irregular, mollusk-like; suckers in five rows, three of which only are developed, and placed on a soft disk or foot; tentacles ten.

P. phantapus. Fig. 117; $\frac{1}{4}$.
Forbesii.

Family IV. Synaptadæ.

Chirodota (Esch.). Body cylindrical, long, slender, without suckers; tentacles long, divided at their tips into finger-like points.

C. digitata. Fig. 118; $\frac{1}{2}$.
Henslowana.

Order III. SIPUNCULOIDEA.

With a retractile proboscis, at the base of which is placed the vent, and round the extremity of which is a circle of tentacles . . . *Sipunculidæ.*

With a retractile proboscis, with no tentacles; the vent at the end of a long thread-like tail . . . . . *Priapulidæ.*

With a proboscis, which has a long fleshy appendage attached; no tentacles; the vent at the hinder extremity . . . . . *Thalassemadæ.*

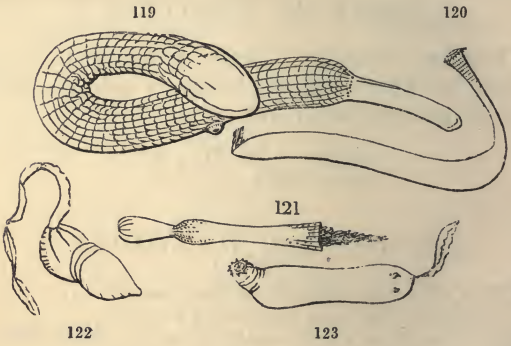
Family I. Sipunculidæ.

Syrinx (Bohadsch). Proboscis cylindrical, shorter than the body, having a circle of short fingered tentacles around its tip.

S. nudus. Fig. 119; $\frac{1}{3}$.
papillosus.
Harveii.

Sipunculus (Linn.). Proboscis cylindrical, about as long as the body, having a circle of simple linear tentacles around its tip.

S. Bernhardus.
Johnstoni.
saccatus.
tenuicinctus.
S. Forbesii.
granulosus.
punctatissimus. Fig. 120; *n. s.*
Pallasii.



Family II. Priapulidæ.

Priapulus (Lamk.). Body truncate behind; tail much branched, pointed.

P. caudatus. Fig. 121; $\frac{1}{3}$.

Family III. Thalassemadæ.

Thalassema (Cuv.). Body cylindrical, rounded and smooth behind; proboscis retractile, short, furnished at one side with a long, fleshy, furrowed, simple sheath, which is not retractile.

T. Neptuni. Fig. 122; *n. s.*

Echiurus (Cuv.). Body cylindrical; set at its hinder extremity with circles of horny points; proboscis as in *Thalassema.*

E. oxyurus. Fig. 123; $\frac{1}{3}$.

Sub-Kingdom III. ANNULOSA.

Class I. TURBELLARIA.

This small Class of animals has usually been confounded with the Worms (Annelida), into which indeed they merge by insensible gradations. They may, however, at once be distinguished by the surface of the body being entirely clothed with vibratile cilia, the currents produced by which may be distinctly seen by a comparatively low microscopic power, though it requires high powers to discern the cilia themselves. The substance of their bodies is of a loose cellular character, slightly consistent, and easily torn, in which the viscera are excavated. In many of the genera the form is exceedingly thin and flat, moving by an even gliding action over solid bodies, like the Gasteropod Mollusca, or swimming by means of a rapid undulation of their thin margins; but in others the body is more nearly cylindrical, and lengthened, sometimes to an excessive degree; and in these there are traces of that division into rings or segments which we see carried to perfection in the Annelida.

The organization of the Turbellaria is very

low, the muscular, the circulatory, and the nervous systems being feebly developed or indistinct. The whole skin seems to be a highly sensitive and delicate organ of touch, and a well-furnished visual apparatus exists in the majority. Two, four, eight, or more specks are visible near the front of the body; sometimes a varying but considerable number are gathered into two clusters, and in one species the whole fore parts are studded with these specks. These are indubitable eyes, which in some cases offer a highly curious and beautiful structure under the microscope.*

The mouth, which is the only opening of the body in most cases, is sometimes placed near the fore extremity, sometimes at the middle, or even behind the middle of the belly. In the Tribe *Dendrocœla*—represented, so far as I am aware, by only one genus in the British seas, that of *Planaria* as restricted,—the mouth opens into a large throat, containing a very moveable swallow (*pharynx*), which can be entirely protruded while the animal is eating, and which, even if separated from the body, still continues for a while to swallow all that is presented to the mouth.†

Many of the species increase by spontaneous division; the body dividing across, when each half becomes a perfect animal, and again divides, and sub-divides. But the more highly organized kinds produce eggs, which are developed in a way quite peculiar to themselves. A large single egg, (or egg-like body,) is laid, in which are gradually formed many roundish embryos; these become flattened and lengthened, and after a while display

* Oersted, "Plattwurmer," pp. 6, 56.

† Baer, "Uber Planarien," Nov. Act. Acad. Leop. 1826, p. 716.

eye-specks, and assume the form of the parent animal. An interesting discovery has been made by Professor Agassiz, that the animals which, under the names of *Kolpoda* and *Paramœcium*, had been described as genera of INFUSORIA, are really the larvæ of *Planariæ;* and probably other Infusorial forms may ultimately prove to be the earlier stages of TURBELLARIA.

Localities.—A large number of the genera are confined to fresh waters. Such as are marine are mostly found between tide-marks, crawling about sea-weeds, or clinging to the under-surfaces of stones. The *Cestoidea* often hide themselves in narrow crevices and hollows of rocks; and a very productive mode of searching for these, as well as many others of that extensive Class that the Shetland fishermen so expressively term "pushen," is to break up the flat friable ledges of sandstone or conglomerate, between which the sea has worked innumerable cracks, sand-layers and caverns; which are found well peopled with strange and uncouth creatures. The curious genus *Serpentaria*, the giant of the tribe, was obtained by Mr. Goodsir from deep water.

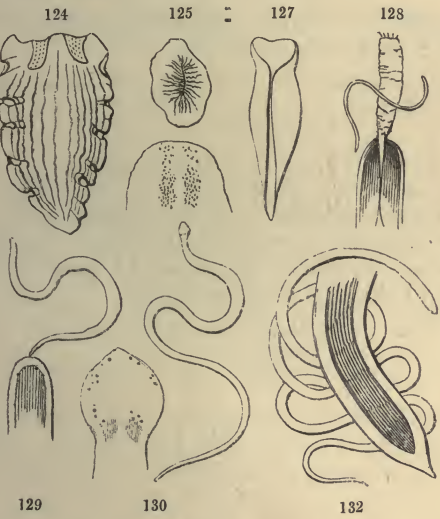
Authorities.—I have used for the arrangement of the Class, Oersted's "Plattwurmer," an admirable little monograph; and for the British species I am chiefly indebted to Dr. Johnston's "Index to the British Annelides," to Mr. Thompson's papers in the "Annals of Nat. Hist.," and my own personal observations.

TURBELLARIA.

Bilateral animals, of soft fleshy substance, covered with vibrating cilia, with the body more or less

lengthened and flattened, but not divided into segments; furnished with organs of sense (eyes), and either sexless or with the sexes united in the same individual.

Body flattened, not greatly longer than broad, without trace of divisions or segments *Planariea.*
Body roundish, linear, greatly lengthened, indistinctly ringed . . . . . *Cestoidea.*



Order I. PLANARIEA.

Intestine branched:

Mouth very large, almost plane, free in a proper cavity, opening near the middle of the belly; eyes in groups . *Cryptocœla.*
Mouth small, cylindrical, free in a cavity, very protrusile . . . . . *Dendrocœla.*

Intestine simple . . . . . *Rhabdocœla.*

Tribe I. Cryptocœla.

Eurylepta (Ehrenb.). No frontal notch; no warts on the body; one sessile group of eyes on the neck; two frontal tentacles.

E. vittata. Fig. 124; *n. s.*
cornuta.

Leptoplana (Ehr.). No notch, warts, nor tentacles; eyes in four groups.

L. tremellaris. Fig. 125; *n. s.*, and *head magnified.*
atomata.

Tribe II. Dendrocœla.

Planaria (Müller). Body oblong; two eyes or series of many eyes near the front; branches of intestines undivided, egg-shaped; mouth opening at or a little behind the middle.

P. flexilis. Fig. 126; *n. s.*
? stagnalis.
? hirudo.

126

Tribe III. Rhabdocœla.

Convoluta (Oersted.) Body oblong-ovate, obtuse

in front, pointed behind; with the margins rolled up together; eyes none.

C. paradoxa. Fig. 127; $\frac{1}{1}^{0}$.

Order II. CESTOIDEA.

Mouth below; vent terminal . . . . *Nemertina.*
Vent below; mouth terminal . . . . *Serpentariana.*

Tribe I. Nemertina.

Astemma (Oerst.). Body linear, roundish; eyes none; mouth not remote from the extremity.

A. rufifrons. Fig. 128; *n. s.*, and *head and proboscis, mag.*

Tetrastemma (Ehr.). Body linear, or linear-oblong; respiratory fissures indistinct; eyes four.

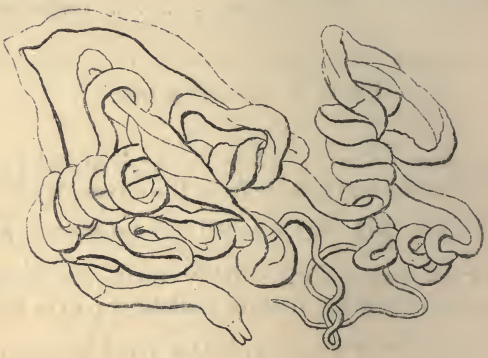
T. quadrioculatum. Fig. 129; *n. s.* and *head mag.*

Polystemma (Ehr.). Body linear, sub-depressed; eyes numerous, in two or four groups; fissures indistinct; two red spots (translucent hearts) in the neck.

P. roseum. Fig. 130; *n. s.* and *head mag.*
pulchrum.
gracile.
armatum.
album.

Nemertes (Cuv.). Body roundish, linear; head and fissures distinct; eyes four to fourteen, in two groups.

N. melanocephala.
bioculata.
octoculata.
purpurea.
Borlasii. Fig. 131 ; *n. s.*
? trilineata.
? filiformis.
? flaccida.
? unicolor.



131

Tribe II. Serpentariana.

Serpentaria (Goodsir). Body depressed, abruptly pointed before, attenuated behind; mouth terminal in front; vent beneath, immediately behind it.

S. fragilis. Fig. 132; $\frac{1}{3}$; and head $\frac{1}{3}$ *n. s.*
gracilis.

Class II. ANNELIDA.

It is now universally acknowledged among naturalists, that the progress of development in the forms and structure of animals cannot be represented by an unbroken linear series, though, from the nature of a book, we are compelled so to treat of them in our descriptive works of zoology. The great Class of Worms is an example in point. At the foot of its scale it manifestly merges into the Turbellaria; and, indeed, the distinction between some of the Leeches and the Planariæ is almost too delicate to be traced, while the *Nemertina* occupy a confessedly disputable border territory. But the Turbellaria lead us into the Infusoria, the simplest forms of animal being; and thus there is a well-trodden highway from those minute and almost structureless creatures, to the active, highly-endowed *Nereis* and *Aphrodita*. There is, however, another pathway by which we may leave the inferior forms of the Annelida, passing into the domains of the Echinodermata by those very worm-like creatures the *Sipunculidæ*, which are no less debateable than are the *Nemertina*. Thus we might descend to the Polypes, and through them to the Protozoa by another route. The same thing might be predicated of the higher extremity of the scale, and it would be easy to show that the Annelida have manifest links of connexion with the Rotifera, with the Myriapoda and Insects, with the Mollusca (through

Aphrodita and *Sabella* on the one hand, and *Chitonellus* and *Dentalium* on the other), and even with the Fishes (through *Myxine* and *Amphioxus*). These indications are enough to show the complex character of the grand plan of created existence, which, instead of resembling a chain, ("the chain of being,") may rather be likened to a coat of chain-mail, in which every link is united with many surrounding links.

The Worms present many points of popular interest. One is the great splendour of colour displayed by many of them. The *Serpulæ* and *Sabellæ* exhibit in their radiating coronets of breathing-organs, not only the most exquisite forms and the most beautiful arrangement, but often glowing hues, usually disposed in bands or lines of spots. The *Pectinaria* carries on his head a pair of combs, that seem made of burnished gold. The *Phyllodoces* are of various tints of green, sometimes very bright, relieved by refulgent blue, as of tempered steel. But it is in the rainbow-hues that are reflected from many members of this Class, that their chief glory lies; for the bodies of many of the *Eunicidæ* and the *Nereidæ* glow with changing colours of great brilliance, and their inferior surface displays the softer tints of the opal or the pearl. The Sea-mouse (*Aphrodita*), one of the most common as well as the largest of our Worms, is clothed with a dense coat of long bristles, which are fully as resplendent as the plumage of the Humming-bird.

The variety of form and construction, of position and arrangement, in the breathing organs of the Worms is a matter well worthy of study. In some, no express organs for respiration exist, but

the function seems to be performed by the whole surface of the body. This is the case with the Earthworms and the Leeches. In the *Serpulæ*, the *Sabellæ*, and their allies, the gills form radiating tufts of stiff threads, forming the beautiful crowns already alluded to, each thread being armed on the upper or inner side with a double row of filaments, like the teeth of a comb,—an exquisite disposition, especially when the animal's action is watched in life and health. In the *Terebellæ*, —those curious worms which burrow in the mud of our shores, and throw abroad their long, twining, thread-like tentacles, as if each had an individual worm-life,—the gills are little tufts, branched like tiny shrubs, three on each side of the neck. In the Lug (*Arenicola*), which the fisherman digs up for bait, the tufts are arranged in a row on each side of the middle part of the body; and, instead of ramifying in all directions like a standard shrub, branch in one plane, like a well-trained fruit-tree against a wall.

Space fails me to describe all the variations exhibited in these organs, especially among the *Cephalana*. In *Euphrosyne* there is a tangled web of shrubbery all down each side; in *Eunice* a double series of threads branched, comb-like, on one side, arch over the middle of the back; in *Myriana*, as also in *Nerine*, &c., the gills are thin curved blades; in *Phyllodoce* they are broad leaves, over which the blood-vessels are seen ramifying in excessive minuteness.

The Sea-mouse, whose glittering mantle of golden hair I have above noticed, displays a most singular economy in its respiration. The back is covered by a thick felt of matted hair, which is permeable

by water, and which, being lifted up by two rows of broad plates placed beneath it, allows the water to filter through it, and to fill a large chamber between it and the back, where it parts with its oxygen through the delicate skin.

No members of this Class have true jointed feet; but most of them are furnished with pencils of projectile bristles, which, pressing by their points against surrounding objects, effect the purpose of locomotion. These bristles are most exquisite objects for microscopic observation, as they display the greatest variety of form, constituting lances, spears, knives, saws, sickles, hooks, and other indescribable weapons, of innumerable elegant shapes, often curiously jointed, and usually fashioned out of an elastic material that rivals the clearest glass.

Almost all the tribe are carnivorous, and many are predatory and ferocious. In general the mouth conceals a great proboscis, which, at the time of feeding, is rapidly turned inside out, and is in many species armed with one or more pairs of horny jaws.

Localities, &c.—Some of the *Apoda* are permanently, and others are occasionally parasitic on other animals; adhering to them by broad sucking-disks, and extracting their vital juices. The *Cephalobranchia* for the most part inhabit tubes of their own manufacture, which are either shelly, as those of the *Serpulæ* and *Spirorbes*, or built up of grains of sand, and fragments of shells, as those of the *Terebella*, *Pectinariæ*, and *Sabellariæ*, or consist of a membranous tough exudation from the body of the animal, as in most of the *Sabellæ*, the *Othoniæ*, &c. Some of these attach their tubes to

rocks, stones, and shells, and even sea-weeds, either in deep water or between tide-marks, and others are free; while some, which do not form proper tubes, burrow in the soft mud at low-water-mark. A great number of the *Cephalana* rove freely about the littoral algæ and rocks, searching for prey, and multitudes of the more minute kinds may always be obtained by plucking up tufts of the common Coralline from low-water-mark, and placing them in a vase of sea-water, when the worms will crawl up the sides of the glass. Many kinds burrow in sand, and are to be found only by digging; and others, as the Sea-mouse, are inhabitants of the deep, and are brought up by the dredge.

Identification.—The points which require special attention in the study of these animals are the following:—The presence, number, and position of sucking-disks; the existence of bristles; the lateral warts called "feet," which usually carry these organs; their form; the relative size and position of the "*cirri*," or soft processes (usually more or less resembling threads) which spring from the feet; the gills (*branchiæ*), their shape, position, and arrangement; the presence of overlapping shields along the back; the thread-like horns or processes of the head (antennæ or tentacles); the furniture of the mouth; the existence of a protrusile proboscis; the jaws, hooks, knobs, or other hard parts with which it is armed; the presence or absence of a tube as a dwelling, its composition, and its figure.

Authorities.—In the arrangement of the Class I have been mainly guided by M. Milne-Edwards, in the last edition of Lamarck's "Animaux sans

vertébres." For the generic characters I have also been indebted to Messrs. Audouin and M.-Edwards's "Littoral de la France," to M. Moquin-Tandon's "Monographie des Hirudinées," and to the numerous papers of Dr. George Johnston in various zoological periodicals. In the enumeration of British species I have principally depended on the "Index to the British Annelides" of the last-named gentleman, a work which in small space exhibits the concentrated result of immense research and labour,—the additions made to the Irish Fauna by Mr. W. Thompson,—the contributions of Mr. Goodsir, and Professor Allman,—and my own personal researches. It is understood that Dr. Johnston is about to bring out a work on the British ANNELIDA, which is anxiously looked for to dispel the obscurity and confusion which confessedly rest on this, perhaps more than on any other department of our native zoology.

ANNELIDA.

Body lengthened, soft, divided into numerous ring-like segments; without jointed limbs; with an orifice at each extremity of the alimentary canal; blood generally red, circulating in a closed system of arteries and veins; skin not clothed with cilia, except on the breathing organs. Distinct sexes.

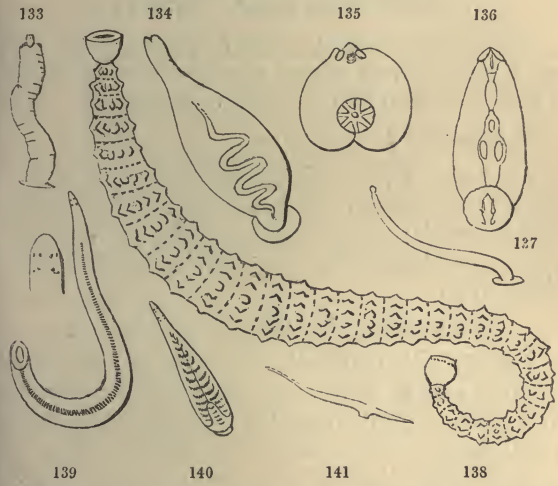
Without bristles, or foot-like warts. Locomotion performed by means of sucking disks	*Apoda.*
With bristles serving for locomotion, and generally carried on foot-like warts, which are furnished with various appendages . .	*Chætopoda.*

Order I. APODA.

Udonella (Johnst.). Body indistinctly ringed; no front sucker; mouth inferior, longitudinal, toothless; no eyes; hind sucker plain.

A minute parasite on *Caligus*, which is itself a parasite on the Holibut.

U. caligorum. Fig. 133; *mag.* $\frac{4}{1}$.



Malacobdella (De Blainv.). Body soft, broad, without distinct rings; no front sucker; no proboscis. Transparent parasites on bivalve Mollusca.

M. grossa. Fig. 134; *n. s.*

Tristoma (Cuv.). Body hard and convex above; soft and flat beneath; two equal disks in front; one larger behind. Parasitical on the Sun-fish.

T. molæ. Fig. 135; *n. s.*

Phylline (Oken). Body soft, sub-oval, flat, a great terminal disk behind, armed with hooks. Parasitical on the Holibut.

P. hippoglossi. Fig. 136; *n. s.*

Piscicola (De Blainv.). Body cylindrical, lengthened, attenuated in front, with a sucker at each end; mouth toothless; eyes four.

P. marina (On the Pogge). Fig. 137; *n. s.*

Pontobdella (Leach). Body cylindrical, lengthened, covered with conical warts; distinctly ringed; a sucker at each end; mouth toothless.

P. muricata. Fig. 138; *n. s.* P. lævis.

Nephelis (Sav.). Body lengthened, depressed, slightly tapering in front, obtuse behind; front sucker small; hind sucker obliquely terminal; mouth comparatively very large, without jaws; eight eyes.

N. octoculata. Fig. 139; *n. s.*, and head *mag.*

Glossiphonia (Johnst.). Body ovate, depressed, slightly convex above, very flat beneath; tapering to a point in front; rounded behind; front sucker small, hind sucker small or moderate, placed exactly beneath: mouth large, without teeth, with a tubular proboscis; eyes from 2 to 8, placed in lines.

G. Eachana. Fig. 140; *n. s.*

Monopus (Gosse). Body sub-cylindrical, depressed: fore sucker imperfect; hind sucker columnar, truncate, one-third of the total length from the tail: eyes eight.

M. medusicola (On a *Medusa*). Fig. 141; *mag.* $\frac{1}{1}^{2}$.

Order II. CHÆTOPODA.

Bristles of two kinds, awl-shaped and hooked; feet with single cirri, or none. No head, eyes, or jaws. Gills on the front	*Cephalobranchia.*
Bristles of only one kind	*Mesobranchia.*

Tribe I. Cephalobranchia.

Bristles of a golden colour, arranged like a crown on the front; numerous tentacles around the mouth; gills in the form of combs. Inhabiting a tube composed of grains of sand	*Auricomadæ.*
Numerous extensile thread-like tentacles around the mouth; gills in the form of little shrubs. Tube composed of sand, minute stones, or fragments of shell . .	*Terebelladæ.*
Gills in the form of a coloured fan, with a fleshy tentacle at the base, on each side of the mouth:	
Both tentacles simply pointed, or wanting. Tube almost always membranous, mingled with clay	*Sabelladæ.*
One of the tentacles expanded into a disk at the tip, which closes the mouth of the tube. Tube solid, calcareous	*Serpuladæ.*

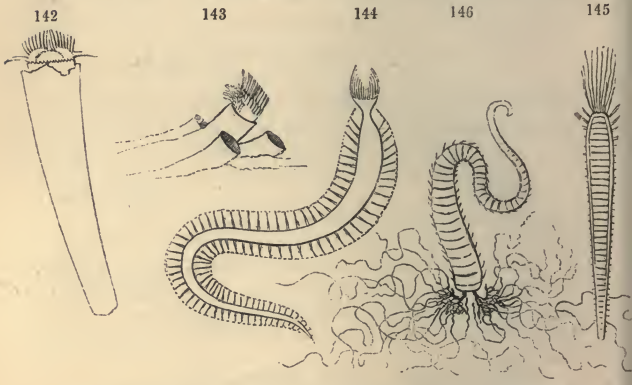
Family I. Auricomadæ.

Pectinaria (Lamk.). Bristles forming two combs, with teeth directed downward. Tube regularly conical, free, formed of grains of sand.

P. Belgica. Fig. 142; *n. s.*
arenaria ?
subcylindrica ?
setiformis ?

Sabellaria (Lamk.). Bristles forming many concentric crowns, forming an operculum of two pieces. Tubes irregular, adherent to other bodies, often much crowded.

S. alveolata. Fig. 143; *n. s.*
crassissima.



Siphonostoma (Otto). Bristles very numerous, forming a concave fan on each side of the head; gills consisting of tufts of soft threads placed within the concavity of the fans, and on each side of the mouth; two short fleshy tentacles: no proper tube.

S. vestitum (Gosse MS.) Fig. 144; *n. s.*
uncinatum.
gelatinosum.

Flemingia (Johnst.). Bristles eight in number, green, retractile; two thread-like tentacles; body hairy, with sixty pairs of feet, bearing bristles which are not retractile. (A singular worm, of doubtful position.)

F. plumosa. Fig. 145; *n. s.*

Family II. Terebelladæ.

Terebella (Cuv.). Body of few segments, with a number of long, very moveable, worm-like tentacles; gills much branched.

T. conchilega. Fig. 146; *n. s.*
chrysodon.
lumbricalis.
cristata.
cirrhata.
nebulosa.
T. constrictor.
venustula.
gigantea.
? curta.
? compressa.

Family III. Sabelladæ.

Othonia (Johnst.). Gill-fans two, composed of many soft, thick, curled inward and pectinated stems, set like a star around the mouth; body composed of twelve to thirty-five segments; all furnished with lateral pencils of bristles, but without hooks; inhabiting a membranous tube open at both ends.

O. Fabricii.
Bairdii.
O. Johnstoni. Fig. 147; *mag.* $\frac{3}{1}$.
amœna.

Sabella (Linn.). Gills of many slender, finely pectinated rays, arching outwards, forming a funnel, often arranged spirally: body of numerous segments: inhabiting a tube usually leathery, closed and attached at the base.

*

S. reniformis.
infundibulum.
vesiculosa.
penicillus.
carnea.
rosea.
bombyx.
flosculus.

* *

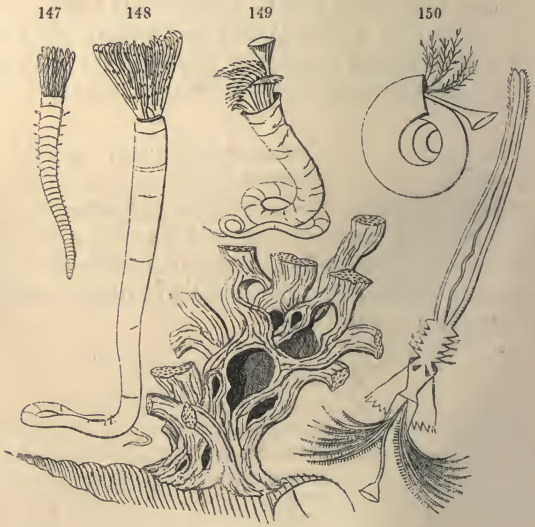
S. tubularia. Fig. 148 ; *n. s.*

* * *

S. volutacornis.
chloræma.

Family IV. Serpuladæ.

Serpula (Linn.). Body depressed, attenuated behind; segments numerous and close-set; gill-threads many, arranged in two fans. Tube calcareous, irregularly twisted, cemented to submarine bodies.



S. intricata.
vermicularis.
triquetra.
contortuplicata. Fig. 149; *n. s.*
S. serrulata.
filiformis.
rugosa.
Cordineri.

Spirorbis (Lamk.). As *Serpula*, but with only six gill-threads, which are pinnate, retractile and radiating. Tube coiled in a flat spiral, cemented to seaweeds and other submarine substances.

Dextral.

S. communis. Fig. 150; *mag.* $\frac{10}{1}$.
spirillum.
granulatus.
carinatus.
corrugatus.
Montagui.
S. incurvatus.
pervius.
retortus.
annulus.
heterocliticus.
striatulus.

Sinistral.

S. heterostrophus.
minutus.
conicus.
S. lucidus.
reversus.

Filograna (Berkeley). As *Serpula*, but with only eight gill-threads, of which two bear a funnel-shaped obliquely-truncate operculum. Tube slender, thread-like, crowded into an irregular mass.

F. implexa. Fig. 151; *n. s.*

Ditrupa (Berkl.). Gills of twenty-two threads in two sets, not rolled spirally, singly pinnate. Tube free, open at both ends.

D. subulata. Fig. 152; *mag.* $\frac{2}{1}$.

Tribe II. Mesobranchia.

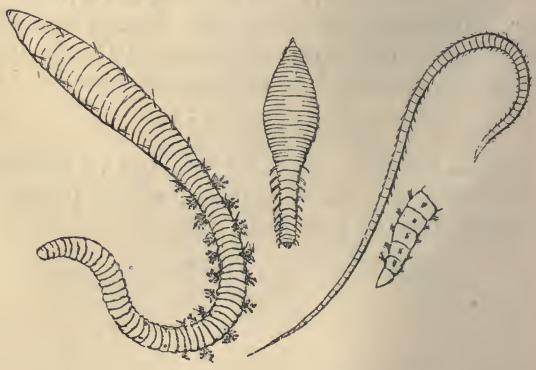
Trunk with no gills, distinct head, eyes, antennæ, or jaws . . . . . *Terricolana.*
Trunk with gills; head small, or indistinct; no jaws nor antennæ; and generally no tentacular cirri . . . . . *Arenicolana.*
Trunk furnished with a distinct head, with antennæ and eyes, and generally with an evertile proboscis armed with jaws . . *Cephalana.*

Sub-Tribe I. Terricolana.

Lumbricus (Linn.). Body round, pointed at each end, with a distinct thickening at one part; four pencils of bristles on each segment, and no long brushes in front.

L. lineatus.
capitatus. Fig. 153; *n. s.* and head *mag.*
minutus.
rufescens.

154 155 153



Sub-Tribe II. Arenicolana.

Arenicola (Lamk.). Body round, swollen behind; gills in branched tufts, arranged on the central segments; mouth terminal.

A. piscatorum. Fig. 154; $\frac{1}{2}$ *n. s.*
branchialis.
carbonaria ?
ecaudata.

Travisia (Johnst.). Body somewhat flattened, swollen in front; gills a pair of simple filaments on each of the hinder segments; mouth beneath.

T. Forbesii. Fig. 155; *n. s.*

Nerine (Johnst.). Feet alike, two-branched; each branch consisting of a membranous lobe, and a short bristled foot-stalk; gills short, thread-like, bent up over the back, with a small cirrus at the base of each: two long tentacles on the back of the head: eyes four. Burrowing in mud.

N. vulgaris.
coniocephala. Fig. 156; $\frac{2}{3}$ *n. s.*

Spio (Gmelin). Gills thread-like, simple; two very long tentacles; four eyes. Inhabiting tubes, which are built up of grains of sand.

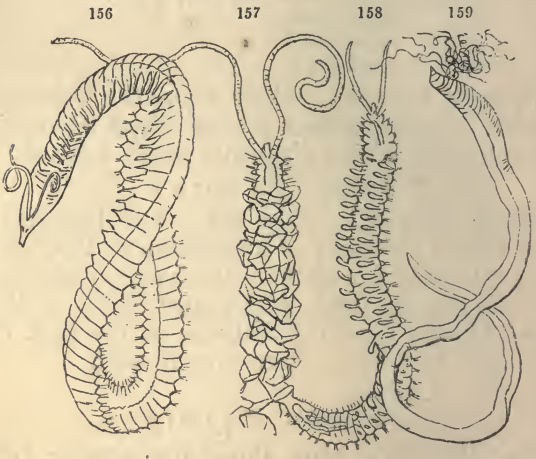
S. seticornis. Fig. 157; *mag.* $\frac{5}{1}$.
crenaticornis.
calcarea ?

Leucodore (Johnst.). Feet of two kinds, dissimilar; those behind the fourth pair carrying leaf-like gills bent over the back: tentacles two on the back of the head: eyes four. Burrowing in mud. [N.B. This seems not sufficiently distinct from *Spio*.]

L. ciliatus. Fig. 158; *mag.* $\frac{5}{1}$.

Cirratulus (Lamk.). Head indistinct, without any appendages; feet two-branched, the upper branch alone bearing a long thread-like cirrus. Lurking under stones.

C. medusa. Fig. 159; *n. s.*
tentaculatus.



Genera imperfectly characterized: apparently of Arenicolana.

Derris (Adams). Head furnished with a flexible proboscis, and two short tentacles. Inhabiting a membranous tube tapering to a point behind; free.

D. sanguinea. Fig. 160, *n. s.*; and head *mag.*

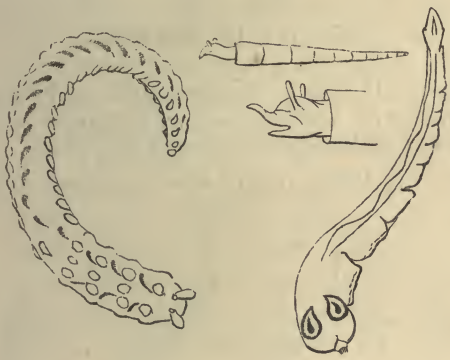
Branchiarius (Montagu). Body irregular, subpellucid, destitute of eyes and tentacles; gills seated on each side; front four-lobed.

B. quadrangulatus. Fig. 161; *n. s.*

Diplotis (Mont.). Body gelatinous; front truncate, with two ear-like tentacles; attenuated behind, and slightly three-pointed.

D. hyalina. Fig. 162; *mag.* $\frac{5}{1}$.

161 160 162



Sub-Tribe III. Cephalana.

Segments equally provided with appendages; no shield-plates.

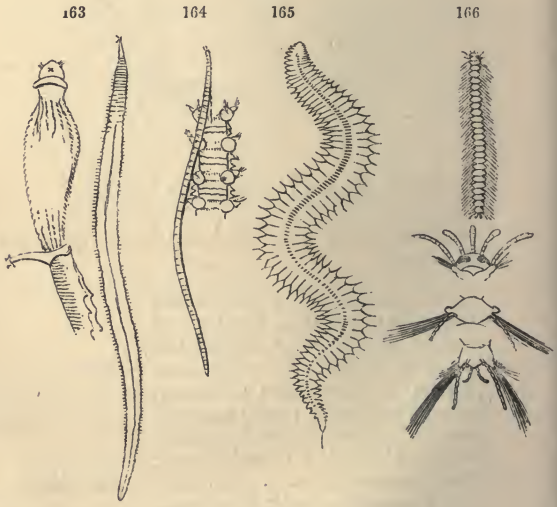
Jaws not exceeding one or two pairs; gills none, or in the form of lobes, or simple leaves, inserted at the top of the foot; *aciculi* present.	*Nereidæ.*
Seven to nine pairs of horny, jointed jaws; gills (when present) in the form of pectinated filaments, inserted above the dorsal cirrus; *aciculi* present	*Eunicidæ.*
No jaws; gills greatly developed, in the form of shrubs, tufts, or plumes, inserted on the back, at the base of the foot; no *aciculi*. .	*Amphinomidæ.*

Segments alternately provided with soft appendages (as shield-plates, or superior cirri); back usually covered by shield-plates; gills rudimentary; jaws ordinarily two pairs . . . . . *Aphroditadæ.*

Family I. Nereidæ.

Glycera (Lamk.). No tentacular cirri; antennæ rudimentary; head conical, and scarcely distinct; proboscis ordinarily armed with four jaws.

G. alba. Fig. 163, *n. s.*; and head with proboscis protruded *mag.*



Pollicita (Johnst.). No tentacular cirri; antennæ rudimentary; body very slender; proboscis without

jaws, the orifice naked; gills in the form of a globose tubercle over each foot; foot simple, warted; tail without styles.

P. peripatus. Fig. 164, *n. s.*; and four of the middle segments *mag.*

Nephtys (Cuv.). No tentacular cirri; antennæ rudimentary; head very distinct, truncate in front; feet of two branches separated by a gill-leaf; proboscis furnished with many rows of tentacles.

N. margaritacea. Fig. 165; *n. s.*
Hombergii.

Ioida (Johnst.). No tentacular cirri; antennæ three, thread-like; eyes two, large; body linear, lengthened; segments numerous; feet simple, each with a dorsal cirrus, and two pencils of bristles.

I. macrophthalma. Fig. 166, *n. s.*; and head, a middle segment, and tail *mag.*

Psamathe (Johnst.). Four pairs of tentacular cirri; antennæ four, unequal, two-jointed; eyes four; proboscis thick, cylindrical, toothless, with warts at its extremity; feet simple, cleft; upper cirrus long, thread-like; lower one short; tail with two styles.

P. fusca. Fig. 167, *n. s.*; and head and two mid. segments *mag.*

Phyllodoce (Cuv.). Tentacular cirri on the first segment; four or five minute antennæ; no jaws; superior cirrus of foot flat and leaf-like; inferior cirrus also leaf-like, but smaller.

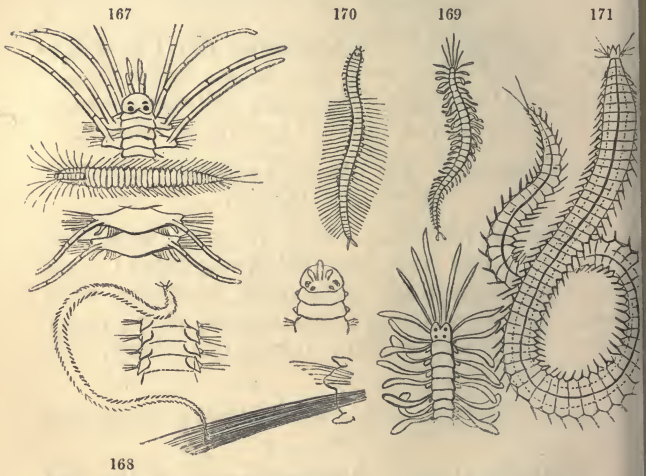
P. lamelligera.
maculata.
bilineata.
P. viridis. Fig. 168; *n. s.* and four mid. seg. *mag.*
marginata.
Paretti.

Myriana (Audouin and Edwards). As *Phyllodoce*, but the inferior cirrus is thread-like.

M. pennigera. Fig. 169, *n. s.*; and head and fore parts *mag.*

Syllis (Savigny). Superior cirri thread-like; feet simple; no jaws; three long, bead-like, similar antennæ; body very long.

S. armillaris.
prolifera.
longiseta.
S. noctiluca.
tubifex.
Fig. 170, *mag.* $\frac{6}{1}$; and fore parts and one foot further *mag.*

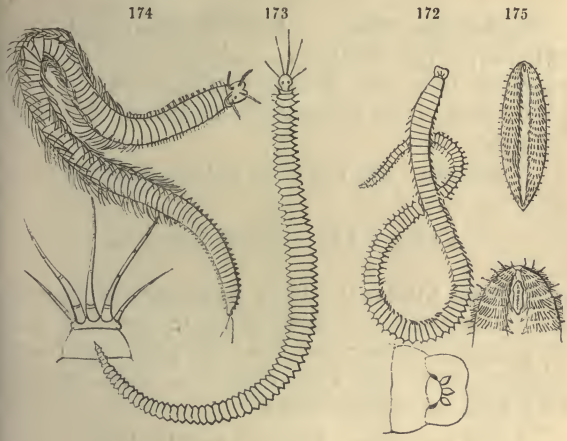


Nereis (Linn.). Feet with two very distinct branches; gill-warts at the tip of foot; two jaws; antennæ dissimilar.

N. brevimanus.
viridis.
pelagica.
N. bilineata.
Dumerilii.
fucata.

N. renalis.
longissima.
margaritacea.
pulsatoria.
iricolor.
margarita.
lineata.

N. maculosa.
rufa.
mollis.
octotentaculata.
punctata.
tubicola.
versicolor. Fig. 171 ; *n. s.*



Family II. Eunicidæ.

Lysidice (Sav.). No gills. Three awl-shaped antennæ ; seven jaws.

L. rufa.
Ninetta. Fig. 172, *n. s.* ; and head *mag.*

Onuphis (Aud. and Edw.). Gills more or less pectinated, fixed above the superior cirrus ; seven antennæ (four on the head and three on the neck).

O. tubicola. Fig. 173, *n. s.* ; and head *mag.*

Eunice (Aud. and Edw.). Gills as in *Onuphis;* five antennæ; gills pectinated on one edge.

E. sanguinea. Fig. 174; $\frac{1}{3}$ *n. s.*
pinnata.

Family III. Amphinomidæ.

Euphrosyne (Sav.). Foot two-branched; one antenna; gills shrub-like, behind the foot, and reaching from one branch to the other; a supplementary cirrus towards the middle of the upper branch.

E. foliosa. Fig. 175, *n. s.*; and fore parts *mag.*

Family IV. Aphroditadæ.

Spinther (Johnst.) Body broadly-oval, convex, without segments or shield-plates; crossed by rows of minute bristles; no head or eyes; proboscis without jaws; feet very numerous, alike, simple, each with an inferior cirrus.

S. oniscoides. Fig. 176; *mag.* $1\frac{1}{2}$ times.

Sigalion (Aud. and Edw.). Body lengthened; shield-plates and dorsal cirri on the same feet; shield-plates on alternate segments as far as the twenty-seventh, whence they continue uninterruptedly to the tail.

S. boa. Fig. 177; *n. s.*

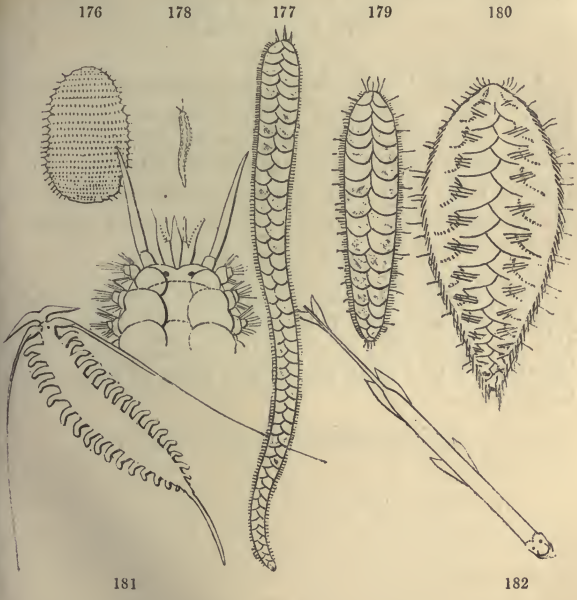
Pholoe (Johnst.). Shield-plates on alternate feet; cirri none or rudimentary; proboscis with two pairs of horny jaws, the orifice plain; antennæ seven, unequal; eyes two.

P. inornata. Fig. 178, *n. s.*; and fore parts *mag.*

Polynoe (Lamk.). Shield-plates, twelve pairs alternating with the superior cirri, and followed by a number of supplementary shield-plates, appearing and disappearing in another order; four or five antennæ; four eyes; proboscis with horny jaws.

P. squamata.
cirrata. Fig. 179; *n. s.*
impar.

P. viridis.
scolopendrina.
semisquamosa.



Aphrodita (Pallas). Shield-plates and superior cirri not on the same feet, but alternating; jaws cartilaginous and rudimentary, or none; three

antennæ; two eyes. (Shield-plates concealed in the British species by a sort of felt formed of the dorsal bristles.)

A. aculeata. Fig. 180; $\frac{1}{2}$ *n. s.*
hystrix.
borealis.

Animals of doubtful position, probably belonging to the ANNELIDA.

Tomopteris (Eschscholtz) = *Johnstonella* (Gosse). Body long, excessively thin, transparent, cut into many lobes on each side; head furnished with two greatly lengthened antennæ directed backwards, and with two pointed processes in front directed sideways; eyes two; proboscis evertile.

T. scolopendra. Fig. 181; *mag.* $\frac{2}{1}$.

Sagitta (Quoy and Gaimard). Body long, slender, gelatinous, fish-like, with two pairs of lateral fins, and an expanded triangular fin-like tail; head large, with two eyes, and many pairs of expanding hooked jaws.

S. bipunctata (?). Fig. 182; *mag.* $\frac{3}{1}$.

Class III. ROTIFERA.

These are animals so minute as to be appreciable only by the microscope; but affording, by their crystalline transparency, the elegance of their forms, the complexity of their internal structure, their beautiful ciliary wheels, and their lively motions, peculiarly interesting objects of study under that instrument. The great majority of the forms are found only in fresh water, very few indeed being recognised as marine: but these exhibit considerable diversity. The most conspicuous character of the Class is that the front parts are set with one or more circles of cilia, which, waving in regular succession and perfect order, present the appearance, to the eye, of one or more wheels revolving rapidly, as if by the power of machinery.

Localities, &c.—*Synchæta* swims at large through the water, never resting; it is self-luminous, and is one of the causes of the phosphorescence of the sea. *Brachionus Mülleri* and *Pterodina clypeata* occur in the brackish water at the mouths of rivers. The other marine species may often be detected by searching with a pocket-lens the glass sides of a well-stocked Aquarium.

Authorities.—Ehrenberg's "Die Infusions-thierchen" is the standard authority for nomenclature

and arrangement; for the determination of British species I have depended on my own researches, as the Class has been the subject of my special study for some years.

Rotifera.

Animals with articulations more or less distinct, with a skin sometimes leathery, but often forming a transparent shell; with a single jointed foot behind; and in some cases other jointed members; with vibrating cilia forming whirlpools for locomotion, on the front; with a mouth containing complex jaws, often seated within the thorax; with distinct sexes, generally differing greatly from each other; producing shelled eggs.

The marine species are so few that I need not divide them into Orders and Families.

§ 1. Skin flexible.

Furcularia (Lamk.). Body lengthened, compressed, terminating behind in a short tail-like foot armed with two long, diverging, pointed toes; one eye in the front.

F. marina. Fig. 183; *mag.* $\frac{100}{1}$.

Synchæta (Ehr.). Body three-sided, very broad before, tapering behind to a very minute two-toed foot; front set with one or more pairs of bristles; a pendent ear-like lobe on each side, well ciliated; one large eye in the midst of the head.

S. Baltica. Fig. 184; *mag.* $\frac{100}{1}$.

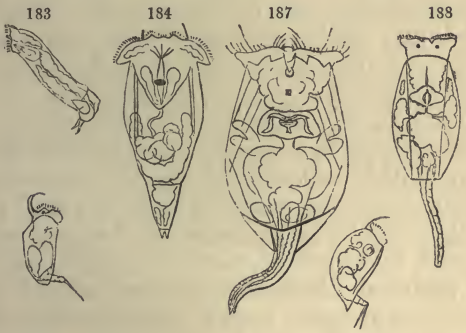
§ 2. Body partially enclosed in a shell.

Monura (Ehr.). Body compressed; shell bivalve; head armed with a moveable hook; two eyes in the front; foot single-toed.

M. coluris. Fig. 185; *mag.* $\frac{100}{1}$.

Colurus (Ehr.). As *Monura*, except that the foot is two-toed.

C. uncinatus.
caudatus. Fig. 186; *mag.* $\frac{100}{1}$.



Brachionus (Pallas). Shell somewhat three-sided, spinous in front, rounded behind; a long, very flexible foot ending in two small toes; one large eye in the midst of the thorax.

B. Mülleri. Fig. 187; *mag.* $\frac{100}{1}$.

Pterodina (Ehr.). Shell much depressed, rounded on all sides; a long flexible foot without toes, ciliated at the tip; two eyes in front.

P. clypeata. Fig. 188; *mag.* $\frac{100}{1}$.

Class IV. CRUSTACEA.

(Crabs.)

Numerous limbs formed of distinct joints are for the first time met with in the animals now before us; they are arranged in pairs along the sides of the body, but on the inferior or belly-surface. The body is itself also divided into rings or segments, which fit into one another, less numerous, but more distinctly marked, than those of the Annelida. These segments are, *theoretically*, twenty-one in number; but in every known species some or other of them are so united, *soldered* as it were, to their fellow segments, as to be undistinguishable; and therefore it is only by an examination of a great variety of forms, that the total number can be recognised. The principal divisions are those of the *head*, *thorax*, and *abdomen*, each of which contains seven segments; but those of the head are usually much crowded and very minute; those of the thorax are more or less covered above by a great shield, called the *carapace*, and are visible only beneath; but those of the abdomen are generally well marked.

Each segment is furnished with a pair of appendages, more or less developed; and the presence of these is often sufficient to indicate a segment, though no trace of division can be detected in the body. The appendages take different forms in different parts of the body; consisting of—1. the

eye-stalks; 2. the upper antennæ (or jointed horns); 3. the lower antennæ; 4. the mandibles (or jaws); 5, 6. the two pairs of maxillæ (or secondary jaws); 7, 8, 9. the three pairs of foot-jaws, one of which belongs to the head, the other two to the thorax; 10—14. the five pairs of true feet; 15—19. the five pairs of false or swimming feet; 20. the swimming plates of the fan-like tail; 21. the minute styles at the very extremity of the body. All these members can be separated in the case of the common Prawn.*

The body in these animals is encased in a skin which, from the deposition in its substance of salts of lime, acquires a considerable consistence. In some of the lower forms, it may be compared to very thin horn; but in the larger *Brachyura*, as in the Eatable Crab, every one knows that it is almost of a stony hardness. Hence the name of CRUSTACEA. The strength of resistance thus obtained is most concentrated in the carapace, that great buckler which in the most familiar species covers the thorax, and protects the vital organs. In many forms, however, as all those which constitute the Order *Edriophthalma*, there is no carapace.

Theoretically, every segment is formed of two arches or semicircles, each of which consists of a pair of central and a pair of lateral pieces. Of these it is necessary to specify here only the lateral pieces of the upper arch, called *epimera;* since they are often well-marked, and furnish important distinctive characters, as in the Tribe *Gammaracea.*

Almost all the members of the Class, and, of

* See Bell's "British Crustacea" (Introduction), p. xx.

course, all of which I am treating, are aquatic, and breathe by means of gills, which are variously modified in the different groups. In the more advanced forms, as the Crabs, we see them, on removing the carapace, as two sets of angular, pointed, whitish, finger-like organs, each of which is composed of a vast multitude of thin plates, very closely packed, but admitting the water between them, which is kept in constant circulation by the play of innumerable cilia. Each series is enclosed in a chamber, which has two openings, one for the admission of the surrounding water, the other for its emission.

In other Orders the gills take the appearance of tufts, or fine filaments, and are placed at the bases of the legs, or on the legs, or on the false feet, or are altogether wanting; the skin, either wholly or in part, in this last case, probably performing the function of vivifying the blood.

The increase of the species is maintained by means of eggs, which are proportionally minute and numerous (in these respects differing signally from those of the ROTIFERA, which are few and enormously large); the collection of eggs, termed spawn, is commonly carried by the female, either beneath the thorax or abdomen, until the time (or nearly) when the young are hatched. These in general appear under forms widely different from those of the parent animals, which they attain only by passing through a series of transformations, by the successive casting off of the outer skin.

The same process of sloughing the skin or crust is continued through life, or, at least, long after the ultimate form is attained, and until the animal has reached its full dimensions. This is a needful pro-

vision for growth, as the rigidity of the encasing armour forbids the possibility of increase in its capacity. The growth, therefore, is periodic: at certain intervals the hard crust is thrown off in several pieces, a new crust having been prepared beneath, which is at first soft, flexible, and expansile; the body, now freed, instantly enlarges in all directions, and in a few minutes has attained the full extent of growth needed; the crust at once hardens, and in a brief space becomes as inflexible as was its predecessor, admitting no further enlargement either of its own surface, or of the contained organs. The animal usually undergoes this process in the most retired situation it can find, instinctively conscious of its unprotected condition when soft, and apparently feeling sick and feeble.

Among the most singular creatures of this great Class are those comprised in the Orders *Epizoa* and *Entomostraca*. The former exhibit shapes the most *bizarre*, so that the young student can scarcely believe that they are animals at all. They are parasitic in their habits, usually living attached to the gills, or to the interior of the mouth of fishes; and to fit them for this mode of life, they are furnished with strange organs of many forms. It is necessary that they should be able so firmly to adhere to their supporters as to resist the force of all ordinary influences to dislodge them; and many are, in fact, so anchored in the flesh, that in order to preserve the *epizoon*, we are compelled to cut out the surrounding parts of the fish. Sometimes this is effected by an array of hooked fangs and pincer-like claws, combined with sucking-disks, as in *Caligus*, while a slender tube pierces the flesh and pumps up the vital juices; some-

times, as in *Chondracanthus*, the foot-jaws, which are stout and armed with strong hooks, are inserted into the victim. In the *Lerneopodæ* we find two long arms proceeding from the thorax, which, meeting at their tips, are united, and bear a knob or button, which, being thrust into the flesh, maintains the hold. In *Achtheres*, a genus that infests the Perch of our rivers, the button at the tip of the united arms is dilated into a bell-shaped cupping-glass, beset within its rim with recurved hooks. In *Lerneonema* and its fellows, the whole head is inserted; and this, being furnished with a prong on each side curving backwards, forms a powerful anchor, by which the parasite is firmly moored to its hapless prey. Finally, in *Lernea* (which, with its long, unsymmetrical, and strangely twisted body, is perhaps the most uncouth of all), the processes of the head are irregularly branched, affording the same sort of hold that a tree obtains in the soil by its spreading roots.

The *Entomostraca* do not present us with any contrivances so strange as these, but the appearance of many of them differs widely from that of the more familiar CRUSTACEA. Their limbs are generally tipped and otherwise furnished with tufts of plumose bristles, some of which appear to answer the purpose of breathing, as well as motion; they commonly have but a single eye, of large size and brilliant colour, in the centre of the forehead; and the carapace is often very large, almost or quite enveloping the animal. In the Tribe *Ostracoda* this is formed of two large convex plates, closely like the valves of a bivalve shell, united over the back by a hinge, but gaping beneath for the protrusion of the feet. In the Tribe *Cladocera*

it constitutes an oval, compressed, shelly box without a hinge, inclosing the whole animal, except at one orifice where the head projects.

A large number of this Order are parasitic upon other marine animals, like the *Epizoa;* with which they agree in another curious circumstance. The females of many species in these groups carry their eggs in two large, oval, cylindrical, or spirally twisted bags (*external ovaries*), sometimes approaching in bulk that of the whole body, and (in some of the *Epizoa*) often greatly exceeding it in length. In *Evadne*, our only marine representative of the Water-fleas (*Daphnia*, &c.), that are so abundant in fresh waters, the eggs are deposited in a sort of chamber in the upper part of the shell, above the back, where the young remain, even for several days after they are hatched.

The lowest forms of all are the *Podosomata*, which in many particulars approach the Spiders so closely, that it is a matter of debate in which Class they should be most naturally placed. I have, however, followed Professor Milne-Edwards in assigning them to the CRUSTACEA.

Localities, &c.—The *Podosomata* and the smaller *Entomostraca* are found (the latter in great abundance) in the tufts of sea-weeds that grow between tide-levels, and the latter also swim in the open sea, and may be collected with a Medusa-net. The *Epizoa* and the parasitic *Entomostraca* dwell, as I have already observed, on other animals, especially fishes; the former chiefly affecting the gills, or gill-pouches; the latter creeping on the surface of the body: the particular prey of each species will be mentioned in detail. The *Cymothoadæ* among the higher forms have similar habits, but most of

the *Edriophthalma* resort to the shallow margins of the sea, weed-fringed rocks, and tide-pools; as do the Prawns (*Palæmon*). The Sand-hoppers (*Talitrus*) are found by myriads in the rotting heaps of sea-weed that lie on the beach, steaming in the sun; and the great *Lygia oceanica* crawls nimbly on the perpendicular sides of rocks that are for many hours left dry by the receding tide. The *Hyperiæ* habitually dwell beneath the shelter of the broad umbrella of certain *Medusæ*, whence they roam out on excursions, returning home at pleasure, as I have elsewhere described.* The *Corophium* lives in mud at the mouths of rivers, over which it roams when the tide is out, beating the mud with its large and powerful antennæ, in its search for prey.

Among the *Podophthalma*, or Stalk-eyed CRUSTACEA, the Shrimps or Sand-raisers (*Crangon*), and the *Thalassinadæ* burrow in sand, mostly in shallow water; but *Calocaris* is an exception, for this genus inhabits the mud of the sea-bottom at great depths. Most of the Lobsters and Crabs are inhabitants of deep water, delighting in narrow and inaccessible clefts of rocks, whence they are to be enticed by baited traps sunk in their haunts. Most of these, however, in their earlier life frequent the weedy shallows; and several, as *Galathea*, *Porcellana*, *Carcinus*, *Pilumnus*, &c., are properly shore genera. *Portunus* and its allies swim with more or less dexterity, by means of their dilated oar-like feet; while *Pagurus* takes possession of the deserted shell of some univalve Mollusk, which he drags about with him on the

* "Devonshire Coast," p. 367.

beach or on the bottom. The habits of this genus are highly entertaining.*

Identification.—The development of the mouth and its organs; the number of the eyes, and whether they are immoveable or borne on a foot-stalk; the character of the foot-jaws, feet, and false-feet; the presence or absence of a carapace; the manner in which, and the organs by which, breathing is performed; the development of the abdomen; the form and office of the plates near its extremity; the form of the antennæ with their appendages; the presence and the form of the frontal beak;—are the points that principally claim attention in distinguishing the various genera.

Authorities.—I am mainly indebted to the valuable "Hist. Nat. des Crustacés" of Professor M.-Edwards for the general arrangement of the Class, slightly modifying his nomenclature. For the British species Professor Bell's "Stalk-eyed Crustacea" has been the text-book, so far as one Order extends; while for another the "British Entomostraca" of Dr. Baird has afforded materials. For the rest I have consulted the magnificent collection in the British Museum, and the "List of Specimens" in that collection by Mr. Adam White, adding a few new species recently introduced to our British Marine Fauna by myself and others.

Crustacea.

Articulated animals; provided with jointed limbs; breathing by gills, sometimes covered, sometimes exposed, but not inclosed in special cavities of the body: eyes generally two, com-

* See "Aquarium," p. 163, *et seq.*

pound; antennæ generally four; jaws generally three pairs; foot-jaws (to the same number), of which the outer pairs often have the office of feet; and feet (usually five pairs, or, when the foot-jaws become feet in function, seven pairs). The skin is usually a solid crust, more or less calcareous, which is cast off at intervals during growth. In the early moultings they sustain a true metamorphosis.

Mouth prolonged into a sucker . . .	*Thelastia.*
Mouth armed with jaws	*Dactia.*

Section I. Thelastia.

Feet formed for walking, and well-developed; mouth without distinct jaws	*Podosomata.*
Feet formed for swimming, or rudimentary: mouth armed with style-like jaws:	
Thorax unjointed; antennæ deprived of appendages; feet always rudimentary or deformed; foot-jaws rudimentary	*Epizoa.*
Thorax with many distinct joints, carrying three or four pairs of feet; foot-jaws well-developed	*Siphonostomata.*

Order I. PODOSOMATA.

Head lengthened, with a three-lobed mouth. Thorax consisting of four segments; with a rudimentary tubular joint, representing the abdomen. Head unfurnished with appendages. Eyes four, grouped on a wart, on the first joint of the thorax. Both sexes have four pairs of walking

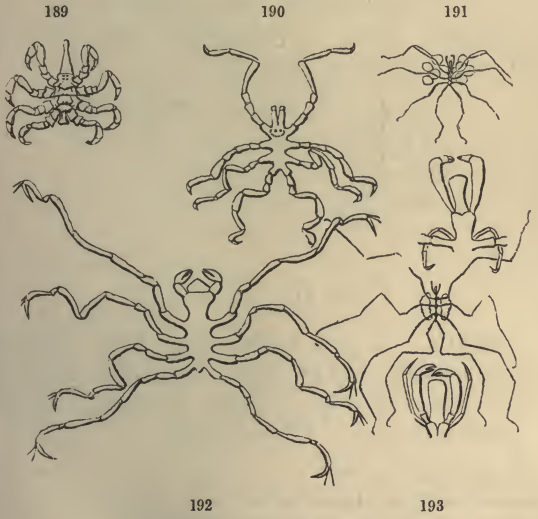
feet, and the females have a pair of false feet besides, for carrying the eggs.

Without foot-jaws	*Pycnogonidæ.*
With foot-jaws	*Nymphonidæ.*

Family I. Pycnogonidæ.

Pycnogonum (Fabr.). Body short and thick; limbs little longer than the body; false feet of female six-jointed. Parasitic on *Cetacea.*

P. littorale. Fig. 189; *n. s.*



Phoxichilus (Latreille). Body slender; feet slender and very long; false feet of female seven-jointed.

P. spinosus. Fig. 190; *mag.* $\frac{3}{1}$.

Family II. Nymphonidæ.

Phoxichilidium (M.-Edw.). Without palpi; head very short; false feet of female five-jointed.

P. coccineum. P. olivaceum. Fig. 191, *n. s.*; and head *mag.*
globosum.

Pallene (Johnst.). Without palpi; head lengthened; false feet nine or ten-jointed.

P. brevirostris. Fig. 192; *mag.* $\frac{6}{1}$.

Nymphon (Fabr.). Furnished with foot-jaws, and palpi; feet very long.

N. gracile. Fig. 193, *n. s.*; and head *mag.*
grossipes.
femoratum.
pictum.
giganteum.

Order II. EPIZOA.

Parasitic. Limbs rudimentary lobes, without joints, serving only to fix the animal to its prey. Form very unusual. Eyes wanting. Thorax without segments. Males minute.

Female fixed by the head, which is provided with two lateral horns . . . *Lerneadæ.*
Female fixed by long arm-like appendages of the thorax, which unite at the tip and form a button-like sucker . . . *Lerneopodadæ.*
Female fixed by foot-jaws, which are stout, and armed with strong hooks . . *Chondracanthadæ.*

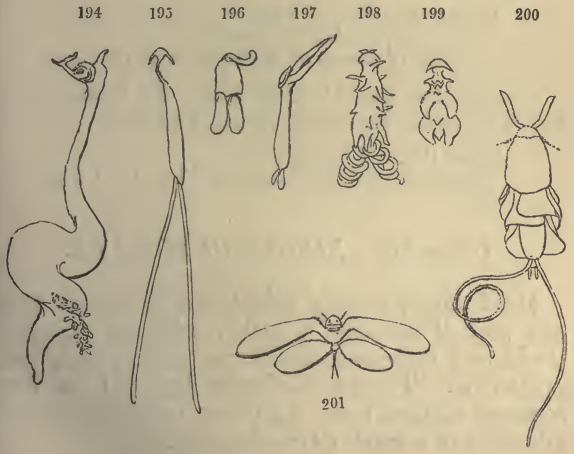
Family I. Lerneadæ.

Lernea (Linn.). No vestiges of feet; body twisted; horn-like appendages irregularly branched; ovaries forming twisted masses beneath the abdomen.

L. branchialis (On the gills of the Cod). Fig. 194; *n. s.*

Lerneonema (M.-Edw.). Several pairs of minute feet near the head; body slender, narrowed to a long neck; head swollen, with simple recurved horns; ovaries linear. (On the Sprat.)

L. spratta. Fig. 195; *n. s.*
encrasicholi.



Family II. Lerneopodadæ.

Anchorella (Cuv.). Arms short, and united from the base; body short, swollen; head small, at the end of a long recurving neck. (On the Cod.)

A. uncinata. Fig. 196; *mag.* $\frac{2}{1}$.
rugosa.

Lerneòpoda (De Blainv.). Arms long, united only at the tip; body long, oval; head short, thick.

L. elongata (Shark). L. salmonea (Salmon).
galei (Shark). Fig. 197; *n. s.*

Family III. Chondracanthadæ.

Lernentòma (De Blainv.). Foot-jaws three pairs; two pairs of which are prehensile; three pairs of appendages to the thorax, which are divided, but not jointed; ovaries long.

L. cornuta (Gills of Sole).
asellina (Gills of Gurnard).
lophii (Pouches of Angler). Fig. 198; *n. s.*

Chondracanthus (De la Roche). As *Lernentoma*, but the ovaries are short, broad, and flat.

C. zei (Gills of Dory).
lophii (Pouches of Angler). Fig. 199; *n. s.*

Order III. SIPHONOSTOMATA.

Head large, usually shield-like, furnished with one pair of antennæ, a sucker with style-formed jaws, and foot-jaws which are anchor-like, and prehensile. Thorax distinctly jointed; its first segment without feet. Abdomen rudimentary, terminating in a small swimming-tail.

Head thick, obtuse, with two slender, cylindrical, bristle-like, many-jointed antennæ . . . . . *Pachycephala.*
Head shield-like, armed with frontal plates; antennæ dilated, two-jointed . *Peltocephala.*

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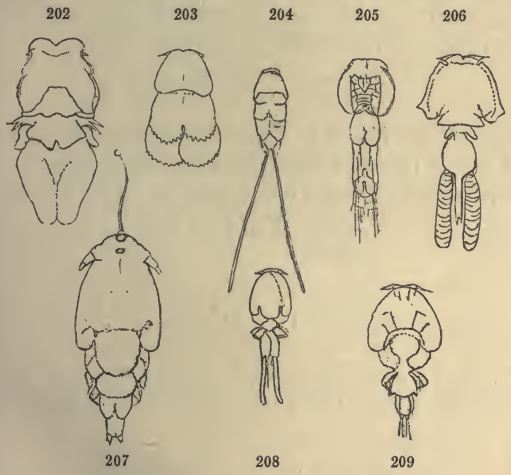
Tribe I. Pachycephala.

Anthosoma (Leach). Head large, oval; body lengthened. Thorax furnished with large plates; all the feet leaf-like; foot-jaws large.

A. Smithii (On Shark). Fig. 200; *n. s.*

Nicothoe (M.-Edw.). Head round; body pear-shaped; thorax dilated into two large wing-like lobes; foot-jaws very small.

N. astaci (On gills of Lobster). Fig. 201; *mag.* $\frac{2}{1}$.



Tribe II. Peltocephala.

Swimming plates on the dorsal surface of thorax	*Pandaridæ.*
No swimming plates on thorax . .	*Caligidæ.*

Family I. Pandaridæ.

Cecrops (Leach). One plate on thorax, small and rounded; ovaries twisted, and hidden under a shield; first three pairs of feet in female and all in male tipped with spines, and fitted for walking.

C. Latreillii (On Sunfish). Fig. 202; *n.s.*

Læmargus (Kroyer). Thoracic plate large; feet leaf-like and respiratory.

L. muricatus (On Sunfish). Fig. 203; *n.s.*

Pandarus (Leach). Several pairs of thoracic plates; all the feet armed with hooks, and fitted for walking. (On Sharks.)

P. bicolor. Fig. 204; *n.s.*
Boscii.

Dinemoura (Latr.). One pair of thoracic plates; first three pairs of feet armed with bristles; the last pair leaf-like and membranous. (On Sharks.)

D. alata. Fig. 205; *n.s.*
lamnæ.

Family II. Caligidæ.

Trebius (Kroyer). Fourth pair of feet two-branched, fitted for swimming; no suckers on frontal plates.

T. caudatus (On Skate). Fig. 206; $\frac{3}{1}$.

Chalimus (Burmeister). Fourth feet simple, fitted for walking; frontal plate furnished with a long and slender filament, bearing a sucker at its tip.

C. scombri (On Mackerel). Fig. 207; $\frac{10}{1}$.

Lepeoptheirus (Nordmann). Feet as in *Chalimus;* frontal plates destitute of suckers.

L. Strömii (On *Salmonidæ*).
pectoralis (Various fishes).
Nordmanni (Sunfish).
hippoglossi (Holibut). Fig. 208; *n. s.*
obscurus (Brill).
Thompsoni (Turbot).

Caligus (Müll.). Feet as in *Chalimus;* a pair of sucking-disks on the lower surface of the frontal plates.

C. diaphanus (Various fishes). Fig. 209; *n. s.*
rapax (Various fishes).
Mülleri (Various fishes).
centrodonti (Sea Bream).
minutus (Holibut).
curtus (Ray).

Section II. Dactia.

Gills attached to the feet or to the jaws; feet ciliated; eyes usually united into one; carapace either in the form of an encasing buckler, or of a bivalve shell. *Entomostraca.*

The modified legs performing the office of gills; eyes sessile, immoveable; thoracic feet for walking, usually seven pairs; no carapace . . . . . *Edriophthalma.*

Gills normal; eyes stalked and moveable; feet partly for seizing, partly for walking; thorax covered by a carapace . *Podophthalma.*

Order I. ENTOMOSTRACA.

Gills few, attached to the mouth; carapace shield-formed or bivalve; feet five pairs or fewer; eye single, antennæ two pairs . . . . . *Lophyropoda.*

Gills many, attached to the feet; carapace usually a shield more or less ample, but sometimes wanting . . . . . *Branchiopoda.*

Sub-Order I. LOPHYROPODA.

Body divided into distinct rings; carapace a buckler inclosing head and thorax; feet five pairs, mostly fit for swimming; ovary external	*Copepoda.*
Body wholly inclosed in a bivalve carapace; feet two or three pairs, fit for walking; no external ovary	*Ostracoda.*

Tribe I. Copepoda.

Head and thorax consolidated and indistinguishable:

Foot-jaws four pairs; feet four pairs	*Notodelphidæ.*
Foot-jaws two pairs; feet five pairs	*Cyclopidæ.*

Head and thorax firmly articulated, but distinct:

One eye; last pair of feet diverse from the rest	*Diaptomidæ.*
Two eyes; all the feet alike . .	*Cetochilidæ.*

Family I. Notodelphidæ.

Notodelphys (Allm.). One eye; head consolidated with thorax; thorax and abdomen each of four rings; superior antennæ many jointed, inferior antennæ prehensile; foot-jaws four pairs; ovary within the body. Parasitic in the sac of *Ascidia*.

N. ascidicola. Fig. 210; *mag.*

Family II. Cyclopidæ.

Canthocamptus (Westwood). Foot-jaws small, simple; antennæ simple; ovary single.

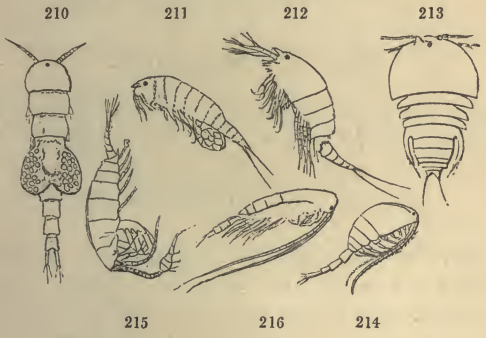
C. Strömii. Fig. 211; $\frac{30}{1}$.
furcatus.
minuticornis.

Arpacticus (M.-Edw.). Foot-jaws with strong claws; antennæ simple; ovary single.

A. chelifer. Fig. 212; $\frac{30}{1}$.
nobilis.

Alteutha (Baird). Foot-jaws simple; body flat, with two strong hooks on the fifth segment.

A. depressa. Fig. 213; $\frac{30}{1}$.



Family III. Diaptomidæ.

Temora (Baird). Head scarcely distinct from thorax; thorax of five, abdomen of three segments; antennæ two-branched; feet five pairs, the first four having each a two-jointed branch.

T. Finmarchica. Fig. 214; $\frac{9}{1}$.

Anomalocera (Templeton). Head distinct, furnished with a two-pointed beak; thorax of six,

abdomen of four segments; antennæ not two-branched; eye in male stalked.

A. Patersonii. Fig. 215; $\frac{5}{1}$.

Family IV. Cetochilidæ.

Cetochilus (Vauzème). Head with two small styles; antennæ two-branched; foot-jaws not branched; thorax of six, abdomen of four segments; last pair of feet of the same form as the others.

C. septentrionalis. Fig. 216; $\frac{5}{1}$.

Tribe II. Ostracoda.

Two eyes; two pairs of feet . . . . . *Cypridinadæ.*
One eye; three pairs of feet . . . . . *Cytheridæ.*

Family I. Cypridinadæ.

Cypridina (M.-Edw.). Eyes two, stalked; antennæ two pairs, both foot-like; feet two pairs, one pair always within the shell, and of a peculiar structure; abdomen ending in a broad plate, armed with strong hooks.

C. Macandrei. Fig. 217; *mag.* C. interpunctæ.
brenda. Mariæ.

Family II. Cytheridæ.

Cythere (Müll.). Eye single; feet three pairs, all external; abdomen short; inferior antennæ with one long, curved, jointed filament; superior antennæ simple, without any pencil of filaments.

C. flavida.
reniformis. Fig. 218 ; $\frac{1}{1}^{6}$.
albo-maculata.
alba.
variabilis.
aurantia.
nigrescens.

C. minna.
angustata.
acuta.
pellucida.
impressa.
quadridentata.
convexa.

Cythereis (Jones). Animal unknown. Valves regularly oblong, with a wrinkled surface, and toothed margins.

C. Whitei.
Jonesii. Fig. 219 ; *mag.*
antiquata.

Sub-Order II. BRANCHIOPODA.

Carapace inclosing the whole animal, except the projecting head ; feet four to six pairs ; eye single . . . . . *Cladocera.*

Carapace wanting, or covering only the head and thorax ; feet eleven to sixty pairs ; eyes two or three . . . . . *Phyllopoda.*

Tribe I. Cladocera.

Evadne (Loven). Feet four pairs, not inclosed ; eye very large ; head not distinct ; abdomen short, scarcely projecting.

E. Nordmanni. Fig. 220 ; $\frac{1}{1}^{0}$.

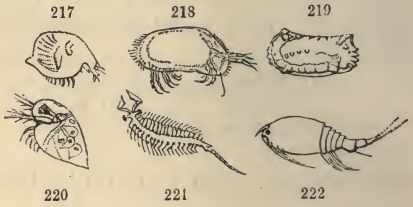
Tribe II. Phyllopoda.

Artemia (Leach). No carapace ; antennæ two pairs, the inferior (in the male) prehensile, flat ; eyes two, stalked, feet eleven pairs ; tail notched, but not divided into two plates. Inhabits brine-pans.

A. salina. Fig. 221 ; $\frac{3}{1}$.

Nebalia (Leach). Carapace large, inclosing head, thorax, and part of abdomen; antennæ two pairs, large, branched; eyes two-stalked; feet twelve pairs, eight being branchial, and four natatory.

N. bipes. Fig. 222; $\frac{2}{1}$.



Order II. EDRIOPHTHALMA.

Abdomen a rudimentary tubercle, without distinct members. Branchial vesicles suspended from the thorax. *Læmodipoda.*

Abdomen well-developed, and provided with five or six pairs of members.

Branchial vesicles almost always absent from the thorax. First five pairs of abdominal members almost of the same form, unsuited to locomotion, and apparently serving as gills . . . *Isopoda.*

Branchial vesicles under thorax. First five pairs of abdominal members diversely formed, and serving for locomotion . . . . . *Amphipoda.*

Sub-Order I. LŒMODIPODA.

Caprella (Lamk.). Body lengthened, slender, cylindrical; both pairs of antennæ well developed;

feet long, but wanting on the second and third segments of the thorax.

C. linearis. Fig. 223; $\frac{2}{1}$.
lævis.
acuminifera.
acutifrons.
phasma.

C. tuberculata.
lobata.
acanthifera.
longispina.

Leptomera (Guerin). As *Caprella*, but all the segments of the thorax furnished with feet.

L. pedata. Fig. 224; $\frac{2}{1}$.

Cyamus (Lamk.). Body ovate, flattened; inferior antennæ minute; feet stout, hooked. (Parasitic on Whales.)

C. erraticus.
ovalis.

C. gracilis.
Thompsoni. Fig. 225; $\frac{3}{1}$.

Sub-Order II. ISOPODA.

Mouth formed for suction, without maxillæ; no appendages, or only two unjointed filaments behind the fifth pair of false feet . . . . . *Sedentaria.*

Mouth furnished with two pairs of maxillæ, as well as mandibles and foot-jaws; a pair of opercular appendages, natatory or style-like, but always jointed behind the fifth false feet:

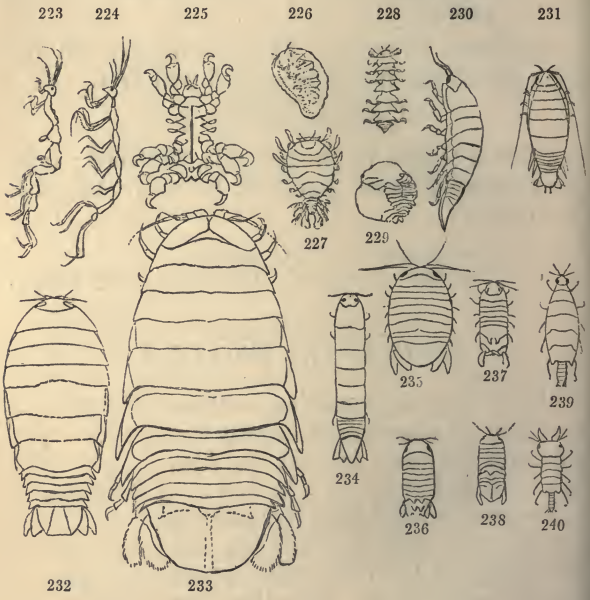
Last false feet terminated by horizontal swimming-plates . . . . . *Natatoria.*

Last false feet style-like or opercular, not formed for swimming . . . . . *Reptatoria.*

Tribe I. Sedentaria.

Abdominal appendages plate-like and hidden beneath the abdomen . . . . . *Bopyridæ.*

Abdominal appendages thread-like, and surrounding the abdomen . . . . . *Ionidæ.*



Family I. Bopyridæ.

Bopyrus (Latr.). Body pear-shaped, depressed, twisted to one side. Parasitic beneath the carapace of Prawns, &c. Female six times as large as the male.

B. squillarum. Fig. 226; *n. s.* hippolytes.

Phryxus (Rathke). Male,—back convex; belly flat; feet formed for walking; gills rudimentary; antennæ short, slender. Female,—back flat; belly convex; feet bent up towards the back; gills large, two-lobed. Parasitic beneath the carapace of *Hippolyte*.

P. hippolytes. Fig. 228 male; 229 female; *n. s.*

Family II. Ionidæ.

Ione (Latr.). Body very flat, long-oval; false feet shrub-like. Male much smaller than female, and carried beneath her body. Parasitic beneath the carapace of *Callianassa*.

I. thoracicus. Fig. 227; *n. s.*

Tribe II. Natatoria.

Thorax of seven distinct segments; seven pairs of feet nearly equally developed; abdomen very short:

First five segments of abdomen distinct and moveable. Last false feet with two moveable plates. Head small. Feet in general anchor-like	*Cymothoadæ.*
First five segments of abdomen soldered together. Last false feet with one or two plates, of which only the outer one is moveable. Head large and transverse. All the feet simple and formed for walking	*Sphæromadæ.*

Thorax of five segments; first two pairs of feet rudimentary or wanting. Abdomen greatly developed . . . *Pranizadæ.*

Family I. Cymothoadæ.

Cirolana (Leach). All the feet simply-clawed; abdomen of six segments.

C. Cranchii. Fig. 230; *n. s.*
hirtipes.

Eurydice (Leach). All the feet simple; abdomen of five segments.

E. pulchra. Fig. 231; *mag.* $\frac{2}{1}$.

Ægа (Leach). First three pairs of feet anchor-like, the rest simply-clawed; inner antennæ enlarged and flattened at the base; eyes remote.

Æ. bicarinata. Fig. 232; *n. s.*
tridens.
emarginata.

Rocinela (Leach). Characters those of *Ægа*; but the eyes close together.

R. Danmoniensis.
monophthalma. Fig. 233; *n. s.*

Conilera (Leach). First three pairs of feet anchor-like; inner antennæ cylindrical at the base.

C. cylindracea. Fig. 234; *n. s.*

Family II. Sphæromadæ.

Sphæroma (Latr.). Capable of rolling into a ball; outer plate of last false feet large, folded beneath the inner one.

S. serratum. Fig. 235; *n. s.*
Hookeri.
Prideauxianum.
S. curtum.
Griffithsiæ.

Cymodocea (Leach). Never rolling into a ball; last false feet projecting, but the outer plate folding beneath the inner; forehead swollen.

C. truncata. Fig. 236; *n. s.* — C. rubra.
emarginata. — viridis.
Montagui.

Nœsea (Leach). As *Cymodocea*, but the outer plate always projecting, and straight.

N. bidentata. Fig. 237; *mag.* $\frac{2}{1}$.

Campecopea (Leach). As *Nœsea*, but the outer plate curved.

C. hirsuta. Fig. 238; *mag.* $\frac{4}{1}$.
Cranchii.

Family III. Pranizadæ.

Praniza (Leach). Head small, rounded; mandibles concealed.

P. cæruleata. Fig. 239; *mag.* $\frac{4}{1}$. — P. maculata.
Montagui. — fuscata.

Anceus (Risso). Head large, four-sided, with two great pincers-like mandibles.

A. maxillaris. Fig. 240; *mag.* $\frac{3}{1}$.

Tribe III. Reptatoria.

Terminal appendages of the last false feet style-shaped or plate-shaped, never covering the under-surface of the abdomen. Last segment of the abdomen minute and not shield-like. Inner antennæ rudimentary — *Oniscidæ*.

Appendages of last false feet style-shaped, prolonged as a tail behind. Last segment

of abdomen very large and shield-like. Inner antennæ small, but distinct . . . . . *Asellidæ*.

Appendages of last false feet very large, plate-like, covering, as an operculum, the whole under-surface of the abdomen; not prolonged behind. Last segment of abdomen very large and shield-like . . . . *Idoteadæ*.

Family I. Oniscidæ.

Lygia (Fabr.). Basal joint of last false feet lengthened, and terminating in two very long styles.

L. oceanica. Fig. 241; *n. s.*

Family II. Asellidæ.

Limnoria (Leach). Abdomen of six segments; antennæ sub-equal.

L. terebrans. Fig. 242; *mag.* $\frac{3}{1}$.

Jæra (Leach). Abdomen of one segment; outer antennæ much longer than inner.

J. albifrons. Fig. 243; *mag.* $\frac{4}{1}$.
Kroyeri.

Oniscoda (Latr.). Last false feet prolonged into two styles; all the true feet alike.

O. maculosa. Fig. 244; *mag.* $\frac{3}{1}$.

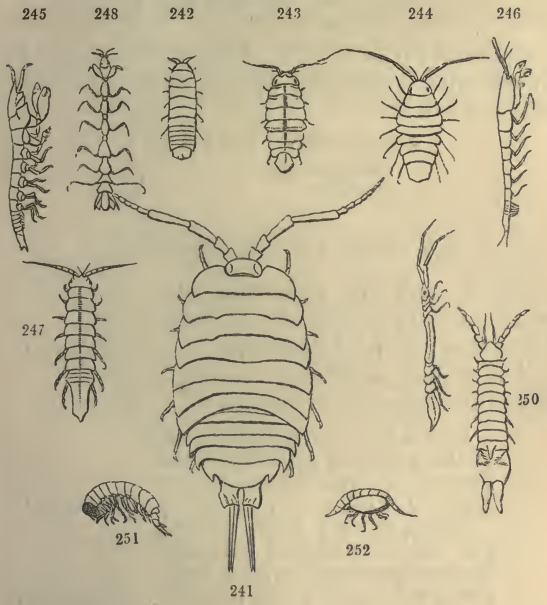
Apseudes (Leach). First feet armed with a two-fingered claw; second feet large, flat, and not resembling the following feet.

A. talpa. Fig. 245; *mag.* $\frac{3}{1}$.

Tanais (M.-Edwards). First feet two-fingered; second feet fanged; antennæ very short, with no

many-jointed lash at the tip; last false feet forming minute styles pointing backwards.

T. Savignyi. Fig. 246 ; *mag.* $\frac{7}{1}$.
Dulongii.



Family III. Idoteadæ.

Idotea (Fabr.). All the feet armed with a pointed claw; two simple plates beneath the abdomen, like folding-doors, which do not extend beyond the last segment.

I. pelagica.
tricuspidata. Fig. 247; *n. s.*
emarginata.

I. linearis.
acuminata.
appendiculata.

Anthura (Leach). Feet clawed; four leaf-like plates beneath the abdomen, which are prolonged on each side on the dorsal surface of the last segment.

A. gracilis. Fig. 248; *mag.* $\frac{2}{1}$.
cylindrica.

Arcturus (Westwood). First four pairs of feet armed with swimming-plates; the rest clawed; antennæ foot-like.

A. longicornis. Fig. 249; *n. s.*
intermedius.
gracilis.

Sub-Order III. AMPHIPODA.

Fourth and fifth abdominal segments united; fourth and fifth abdominal appendages dissimilar . . *Cheluracea.*

Abdominal segments distinct; abdominal appendages similar:

Foot-jaws covering only the bases of the preceding appendages, and forming a lip with three plates, but deprived of palps . . . . . *Hyperiacea.*

Foot-jaws very large, covering the whole mouth, and forming a lip terminated by four great horny plates and two very long palps. . *Gammaracea.*

Tribe I. Cheluracea.

Chelura (Philippi). First three segments of abdomen carrying swimming feet; the remainder supporting a pair of leaf-like appendages and a pair of cylindrical false feet, and terminated by two leaping organs. Bores in submerged timber.

C. terebrans. Fig. 250; *mag.* $\frac{3}{1}$.

Tribe II. Hyperiacea.

Body thick-set; head very large; mandibles large; foot-jaws very small, and not nearly covering the mouth; the lip formed by their union is terminated by a central lobe and two leaf-like plates. Tip of the abdomen forming a swimming organ. (Parasitic on *Medusæ*.)

Hyperia (Latr.). Second pair of antennæ style-shaped and unfolded; body inflated.

H. Latreillei. Fig. 251; *n. s.* galba.

Typhis (Risso). Second antennæ folding on themselves so as to form three or four elbows; first joint of fifth and sixth feet forming great oval plates, concealing all the others.

T. monoculoides. Fig. 252; *mag.* $\frac{5}{1}$.
nolens.

Tribe III. Gammaracea.

Body depressed; epimera very small or obsolete; abdomen straight, normal; three last pairs of false feet tipped with swimming-plates; antennæ foot-shaped . . . . . *Corophiadæ.*

Body much compressed; epimera very large, scale-like, and encasing the bases of the first four pairs of feet; posterior extremity formed for leaping.

Superior antennæ longer than the footstalk of the inferior, and much longer than the head; mandibles carrying long palps; antennæ lash-like . . . . . *Gammaridæ.*

Superior antennæ much shorter than footstalk of inferior, and scarcely longer than head; mandibles without palps . . . . . *Orchestiadæ.*

Family I. Corophiadæ.

Cerapus (Say). Second feet fanged; fang two-jointed; all the antennæ without many-jointed lashes at the tip.

C. pelagicus. C. Whitei. Fig. 253; *mag.* $\frac{6}{1}$.
falcatus.

Podocerus (Leach). First and second feet fanged; fang one-jointed; inferior antennæ without lashes.

P. variegatus.
pulchellus. Fig. 254; *mag.* $\frac{2}{1}$.

Corophium (Latr.). Second feet not fanged; inferior antennæ without lashes.

C. longicorne. Fig. 255; *mag.* $\frac{2}{1}$.

Unciola (Say). First and second feet fanged; all the antennæ tipped with many-jointed lashes; superior pair furnished with a minute appendage at the base of the lash.

U. irrorata. Fig. 256; *mag.* $\frac{4}{1}$.

Family II. Gammaridæ.

Gammarus (Fabr.). Superior antennæ slender at the base, and furnished with a filament; first and second feet fanged; fang of first feet one-jointed.

G. locusta. Fig. 257; head *mag.* $\frac{3}{1}$.
marinus.
camptolops.
pulex.
grossimanus.
G. longimanus.
Cranchii.
punctatus.
carinatus.
maculatus.

Amphithoe (Leach). As *Gammarus*, but the superior antennæ are without an accessory filament.

A. punctata.
fucicola.
obtusata.
Moggridgei.
A. rubricata. Fig. 258; *mag.* $\frac{2}{1}$.
dubia.
spinosa. Fig. 266; *n. s.* } = *Dexamine* (Leach).
carino-spinosa. }

Leucothoe (Leach). Fang of first feet two-jointed; superior antennæ without a filament.

L. articulosa. Fig. 259; *mag.* $\frac{2}{1}$.

Acanthonotus (Owen). None of the feet fanged; superior antennæ without a filament.

A. testudo. Fig. 260; *n. s.*

Anonyx (Kröyer). Superior antennæ thick at the base; furnished with a lash; first and second feet fanged.

A. albus. Fig. 261; *mag.* $\frac{2}{1}$.
elegans.

Opis (Kröyer). As *Anonyx*, but the second feet not fanged; the claws of first feet very large.

O. typica. Fig. 262; *mag.* $\frac{2}{1}$.

Family III. Orchestiadæ.

Talitrus (Latr.). Second feet not clawed; superior antennæ shorter than the base of the inferior, simple; inferior antennæ very long, thread-shaped.

T. locusta. Fig. 263; *n. s.*

Sulcator (Bate). Superior antennæ half as long as the inferior, forked; inferior antennæ with the second joint flattened; second and third feet two-clawed.

S. arenarius. Fig. 264; *n. s.*

Orchestia (Leach). First and second feet clawed; superior antennæ shorter than the base of the inferior; foot-jaws obtuse.

O. littorea. Fig. 265; *n. s.*
Deshayesii.

Genera apparently intermediate between the Edriophthalma and Podophthalma.

Family Cumadæ.

Eyes very small, "pedunculated [*i.e.* stalked], but sessile," very close together, covered by the shell; carapace large, beaked; abdomen long, distinctly jointed; the sixth joint armed with two forked styles; antennæ variable; legs of two sorts; gills comb-like, on the sides of the thorax.

Cuma (M.-Edw.). Superior antennæ one-jointed, scale-like; inferior five-jointed; fork of the tail-styles with each division two-jointed.

C. Edwardsii. Fig. 267; *n. s.*
Audouinii.
trispinosa.

Alauna (Goodsir). Superior antennæ composed of a footstalk and a many-jointed lash; inferior eight-jointed; first three pairs of feet compound; internal division of tail-styles three-jointed, outer division one-jointed.

A. rostrata. Fig. 268; *n. s.*

Bodotria (Goodsir). First five joints of abdomen each armed with a pair of forked false feet; both divisions of tail-styles one-jointed.

B. arenosa. Fig. 269; *n. s.*

Order III. PODOPHTHALMA.

Gills naked, attached to the abdominal false feet. Carapace divided into two parts, the fore part bearing the eyes and intermediate antennæ; eyes moveable, set on foot-stalks.

Gills external, or wanting; only three pairs of members belonging to the mouth . . . *Stomapoda.*

Gills fixed under the sides of the thorax, and inclosed in special cavities; six pairs of members to the mouth; five pairs of thoracic feet . . . . . *Decapoda.*

Sub-Order I. STOMAPODA.

Feet usually seven pairs; almost always provided with accessory appendages. Gills never lodged in a special cavity; they are composed of parallel filaments, which give forth other subordinate filaments, which are again fringed in the same manner. Abdomen greatly developed [in the British species].

First feet very large and fanged; next three pairs short, and terminated by smaller fangs; last three pairs formed for swimming; carapace divided lengthwise . . . . . *Squilladæ.*

All the feet of the same form, provided with a process which makes them appear double. Body compressed; carapace concealing the thorax . . . . . *Mysidæ.*

Body consisting of a thin flat plate; carapace covering only a small part of the thorax; feet excessively long and slender . . . . . *Phyllosomadæ.*

Family I. Squilladæ.

Squilla (Fabr.). Last three pairs of feet furnished with a long style-shaped appendage; fang of first feet flattened and armed with strong teeth.

S. mantis.

Desmarestii. Fig. 270; $\frac{1}{3}$ *n. s.*

Family II. Mysidæ.

Mysis (Latr.). No abdominal or thoracic gills; false feet very small; all the true feet branched.

M. chamæleon. Fig. 271; *n. s.* M. Griffithsiæ.
vulgaris. productus.

Themisto (Goodsir). As *Mysis*, except that the third and fourth false feet give off two branches from their stalks.

T. longispinosa.
brevispinosa. Fig. 272; *n. s.*

Cynthilia (Thomps.). False feet large, two-jointed, and furnished with gills in the form of a spirally-rolled cylinder.

C. Flemingii. Fig. 273; *mag.* $\frac{2}{1}$.

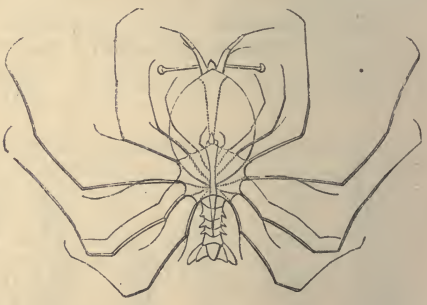
Thysanopoda (M.-Edw.). Gills in the form of plumes at the base of the true feet; last pair of feet unbranched.

T. Couchii. Fig. 274; *mag.* $\frac{2}{1}$.

Family III. Phyllosomadæ.

Phyllosoma (Leach). Carapace broad, oval, leaf-like; thorax similar; eyes on long stalks.

P. commune. Fig. 275; *n. s.*



275

Sub-Order II. DECAPODA.

Feet almost always five pairs. Gills composed of numerous parallel plates enclosed in a cavity on each side of the body. Head soldered to the thorax, and covered with a carapace, which reaches to the abdomen.

Abdomen well developed, carrying swimming organs . . . . . *Macrura.*

Abdomen little developed, without swimming organs:

Appendages on the last segment but one; breast-plate between the bases of the feet partly linear, and partly broad . . . . . *Anomoura.*

Abdomen always bent under the body; no appendages on the last segment but one; breast-plate always broad . . . . . *Brachyura.*

Tribe I. Macrura.

Abdomen large, in general longer than the carapace, stretched out, and serving for swimming; always carrying on its under surface thin swimming organs (false feet), and furnished at its extremity with swimming plates expanding like a fan.

External antennæ furnished with a large, oval or triangular, moveable plate.

Antennæ inserted in two lines.

Beak small or wanting; feet slender; with appendages at the bases; abdomen long and compressed . . . . . *Peneadæ.*

Beak large, compressed and toothed; feet robust, without appendages . . . . . *Palæmonidæ.*

Beak small and flat; feet robust, without appendages; first two pairs two-clawed, and one of them often greatly developed . . . *Alpheadæ.*

Antennæ inserted in the same line; first pair of feet fanged . . *Crangonidæ.*

External antennæ furnished with a small, arrow-shaped, moveable plate — *Astacidæ.*

External antennæ with no moveable plate.

- Abdomen long and slender; breast-plate linear; body lengthened . . . — *Thalassinadæ.*
- Abdomen short or moderate; breast-plate very large; body depressed . . — *Palinuridæ.*

Family I. Peneadæ.

Penæus (Fabr.). First three pairs of feet two-fingered; false feet much enclosed by the abdomen, and terminated by two ciliated plates.

P. Caramote. Fig. 276; ½ *n. s.*

Pasiphœa (Sav.). First and second feet two-fingered; body compressed and lengthened; beak very short and simple.

P. Sivado. Fig. 277; ½ *n. s.*

Family II. Palæmonidæ.

Palæmon (Fabr.). Inner antennæ terminating in three filaments; first and second feet two-fingered; the second much larger than the first; beak long, and compressed.

P. serratus.
squilla. Fig. 278; *n. s.*
Leachii.
varians.

Pandalus (Leach). Inner antennæ terminating

in two filaments; first feet simple; second two-fingered, unequal.

P. annulicornis. Fig. 279; *n. s.*

Hippolyte (Leach). As *Pandalus*, but the first and second feet are two-fingered; abdomen in general abruptly bent downward.

H. spinus.
varians.
Cranchii.
Thompsoni.
Prideauxiana.
pandaliformis.
H. Barleei.
Whitei.
Yarrellii.
Grayana.
Mitchellii.
fascigera. Fig. 280; *n. s.*

276 277 278 279

280

Family III. Alpheadæ.

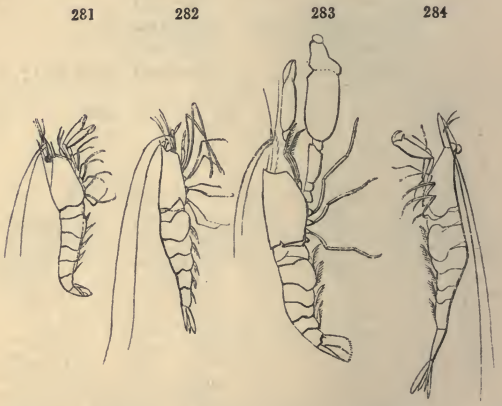
Athanas (Leach). Eyes projecting beyond the carapace; inner antennæ terminating in three fila-

ments; first and second feet two-fingered; the first the larger; the second slender, many-jointed.

A. nitescens. Fig. 281; *n. s.*

Nika (Risso). First feet dissimilar; the right one being two-fingered; the left simple; second pair slender, long, many-jointed, and minutely two-fingered.

N. edulis. Fig. 282; $\frac{1}{2}$ *n. s.*



Alpheus (Fabr.). Carapace forming a vault over the eyes; first feet two-fingered, very stout, and differing much in form from each other; second pair slender, many-jointed, two-fingered.

A. ruber. Fig. 283; *n. s.*
affinis.

Family IV. Crangonidæ.

Crangon (Fabr.). First feet thick, the last joint closing down like a fang upon a projection

of the preceding joint; second pair slender, two-fingered; body depressed.

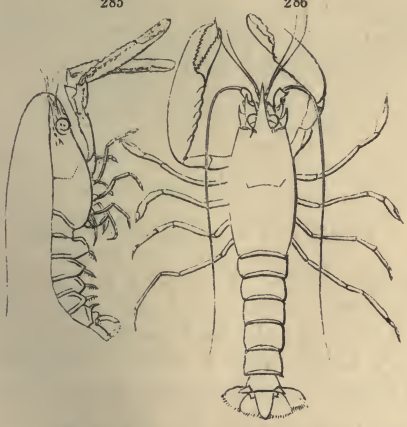
C. vulgaris. Fig. 284; $\frac{1}{2}$ *n. s.*
fasciatus.
spinosus.
sculptus.
trispinosus.
bispinosus.

Family V. Astacidæ.

Nephrops (Leach). Eyes large, kidney-shaped; first three pairs of feet two-fingered; the hands of the first long, unequal, strongly angled, and notched; abdomen sculptured.

N. Norvegicus. Fig. 285; $\frac{1}{5}$ *n. s.*

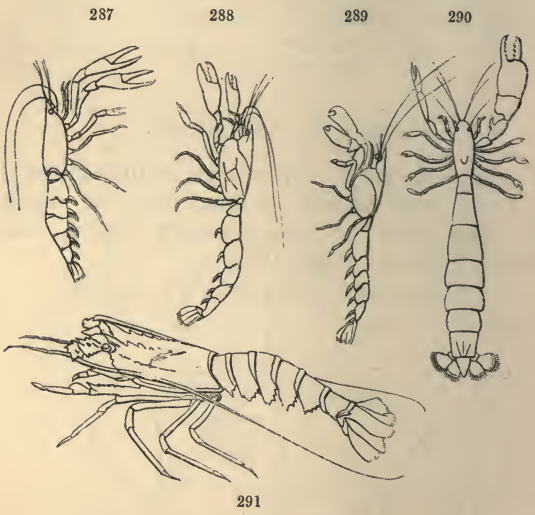
285 286



Homarus (M.-Edw.). Eyes round; last ring of the carapace immoveable; first three pairs of feet two-fingered; the hands of the first very long

and broad, flattened, unequal; one of them toothed, the other knobbed on the inner edges.

H. vulgaris. Fig. 286 ; $\frac{1}{6}$ *n. s.*



Family VI. Thalassinadæ.

Calocaris (Bell). First and second feet two-fingered, slender, lengthened, flattened, the fingers long and pointed; the first much the larger; carapace very large, with a small triangular beak, whence diverge backwards two lines of spines.

C. Macandreæ. Fig. 287 ; $\frac{1}{2}$ *n. s.*

Axius (Leach). First and second feet two-fingered; the hand of the first stout, ovate, un-

equal; all compressed; abdomen lengthened, whole body much compressed.

A. Stirynchus. Fig. 288; $\frac{1}{2}$ *n. s.*

Gebia (Leach). First feet alone two-fingered, the fingers unequal in length; carapace terminating in a small beak; abdomen broad, swelling in the middle, ending in a large swimming-tail.

G. stellata. Fig. 289; $\frac{2}{3}$ *n. s.*
deltura.

Callianassa (Leach). First and second feet two-fingered; one of the hands of the first pair enormously developed, while its fellow scarcely exceeds those of the second pair; third pair with the last joint but one swollen; no beak; abdomen very long and broad.

C. subterranea. Fig. 290; $\frac{2}{3}$ *n. s.*

Family VII. Palinuridæ.

Palinurus (Fabr.). Antennæ long, the outer pair very thick at the base; none of the feet clawed; carapace spinous.

P. quadricornis. Fig. 291; $\frac{1}{6}$ *n. s.*

Tribe II. Anomoura.

Abdomen sometimes bent under the body, sometimes extended, with a swimming-tail more or less developed; breast-plate in general linear between the last three pairs of feet, and enlarged in front: hindmost feet usually rudimentary.

Abdomen terminated by appendages:

Breast-plate almost linear; abdominal appendages fleshy; fourth and fifth feet minute . . . . . *Paguridæ.*

Breast-plate very large; a tail of swimming-plates; fifth feet minute. *Porcellanadæ.*

Abdomen without appendages; bent forward:

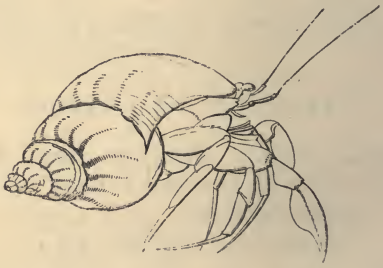
Inner antennæ minute, and lodged in a groove . . . . . *Dromiadæ.*

Inner antennæ long, and exposed. *Homoladæ.*

Family I. Paguridæ.

Pagurus (Fabr.). Inner antennæ short: abdomen soft, rolled on itself; and carrying a pair of appendages which are not symmetrical. Inhabits the shells of Mollusca.

292



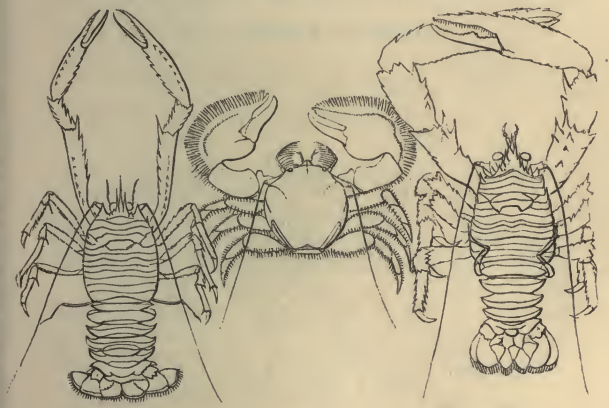
P. Bernhardus.
Prideauxii. Fig. 292; $\frac{1}{2}$ *n. s.*
cuanensis.
ulidianus.
Hyndmanni.
lævis.
Forbesii.
Thompsoni.
fasciatus.
Dilwynii.

Family II. Porcellanadæ.

Munida (Leach). Beak a long slender spine, with two shorter spines above its base; first feet very long, and slender, with long claws; abdomen extended.

M. rugosa. Fig. 293; $\frac{1}{3}$ *n. s.*

293 295 294



Galathea (Fabr.). Beak short, triangular, toothed; carapace broad, flattened; first feet and claws moderate, spinous: abdomen extended.

G. squamifera. Fig. 294; $\frac{1}{2}$ *n. s.*
strigosa.
nexa.

Porcellana (Lamk.). Carapace broad, round, flat and crab-like; abdomen bent under, but tipped

with a swimming-tail; outer antennæ very long; claws large and flattened.

P. platycheles. Fig. 295; *n. s.*
longicornis.

Family III. Dromiadæ.

Dromia (M.-Edw.). Fourth and fifth feet very small, turned so as to lie flat on the back, and ending in a small double claw.

D. vulgaris. Fig. 296; $\frac{1}{4}$ *n. s.*

296 297

Family IV. Homoladæ.

Lithodes (Latr.). Fifth feet minute, without claws, concealed under the edge of the carapace; which is triangular, spiny, with a long, forked beak.

L. Maia. Fig. 297; $\frac{1}{3}$ *n. s.*

Tribe III. Brachyura.

Abdomen little developed, bent under the body, with no trace of a swimming-tail; breast-plate large between all the feet, never linear; carapace broad, and usually flat; hind feet well developed.

Mouth-cavity triangular; its narrow point reaching the front of the carapace.

Carapace generally round, or arched in front, not projecting.

- Outer antennæ very large; gill-orifices before the first feet . . . . . *Corystidæ.*
- Outer antennæ minute; no gill-orifices. *Leucosiadæ.*

Mouth-cavity very large before, and remote from front.

Carapace generally four-sided, or ovate with the front nearly straight.

- Carap. four-sided; eye-stalks very short *Grapsidæ.*
- eye-stalks very long *Gonoplacidæ.*
- Carapace round, as long as wide; front narrow . . . . . *Pinnotheridæ.*

Carapace large and regularly arched in front, narrowed behind.

- Hind feet enlarged; their last joint forming a flat plate, with a fringed edge for swimming . . . . . *Portunidæ.*
- Hind feet ending in a sharp claw . . *Canceridæ.*

Carapace narrow in front, projecting into a beak; broad behind.

- First feet much the longest; hand three-sided; claws bent downward; basal joint of outer antennæ minute. *Parthenopidæ.*
- All the feet nearly equal in length; basal joint of outer antennæ very large . . . . . *Maiadæ.*
- All the feet very long and slender, the second pair much the longest . . *Leptopodiadæ*

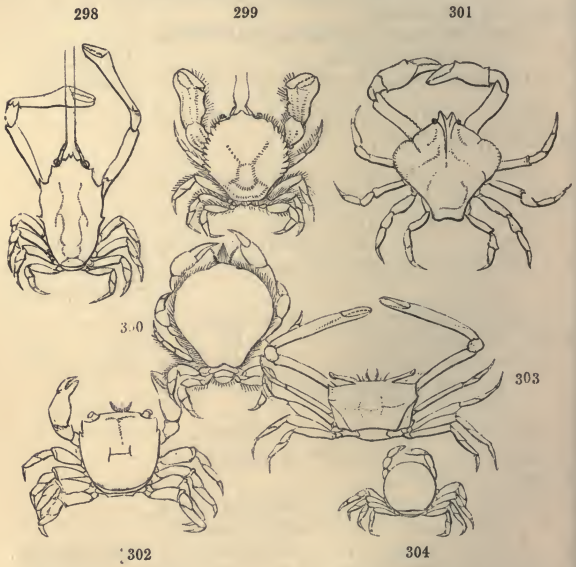
Family I. Corystidæ.

Corystes (Leach). Carapace much longer than wide, ovate, cut with few teeth at the sides; outer antennæ together forming a tube.

C. Cassivelaunus. Fig. 298; $\frac{1}{3}$ *n. s.*

Atelecyclus (Leach). Carapace nearly circular, evenly convex, cut with many teeth.

A. heterodon. Fig. 299; $\frac{1}{2}$ *n. s.*



Thia (Leach). Carapace heart-shaped, narrowed behind, arched from side to side only; front forming a broad plate concealing the eyes.

T. polita. Fig. 300; *n. s.*

Family II. Leucosiadæ.

Ebalia (Leach). Carapace lozenge-form, with rounded angles; front elevated.

E. Pennantii. Fig. 301; *n. s.*
Bryerii.
Cranchii.

Family III. Grapsidæ.

Planes (Leach). Carapace rather longer than broad, nearly square, with the sides rounded, convex; front broad, thin and bent downwards.

P. Linnæana. Fig. 302; *n. s.*

Family IV. Gonoplacidæ.

Gonoplax (Leach). Carapace four-sided, much broader than long, narrowed behind; front the whole width of carapace.

G. angulata. Fig. 303; $\frac{1}{2}$ *n. s.*

Family V. Pinnotheridæ.

Pinnotheres (Latr.). Carapace nearly circular, covering the inner antennæ; mouth-cavity half-moon-shaped. (Minute crabs parasitic within the shells of living bivalve mollusca.)

P. pisum. Fig. 304; *n. s.*
veterum.

Family VI. Portunidæ.

Polybius (Leach). Carapace nearly circular, slightly narrowed behind: all the feet much flattened; last joint of fifth pair very large, oval, and

thin: outer antennæ inserted on the line of the eyes and inner antennæ.

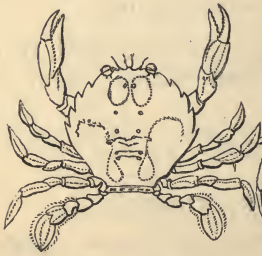
P. Henslowi. Fig. 305; $\frac{1}{2}$ *n. s.*

Portunus (Leach). Carapace rather broader than long, front projecting; second, third, and fourth feet, with the last joint long, slender, pointed, grooved; the last two joints of the fifth flat, broad, and rounded; outer antennæ inserted on the line of the eyes and inner antennæ.

P. puber.
corrugatus.
arcuatus.
depurator. Fig. 306; $\frac{1}{2}$ *n. s.*

P. marmoreus.
holsatus.
pusillus.
longipes.

305



306

307

308

Portumnus (Leach). Carapace as long as broad, round in front, diminished behind; outer antennæ

inserted below the eyes and inner antennæ; last joint of fifth feet, broad, ovate, pointed.

P. variegatus. Fig. 307; $\frac{1}{2}$ *n. s.*

Carcinus (Leach). Carapace four-sided, the front margin wide and arched, strongly toothed; the hind margin narrowed; fifth feet compressed, their last joint thin, but narrow and pointed.

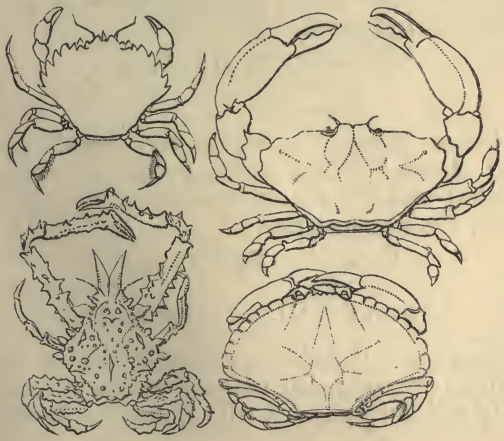
C. Mænas. Fig. 308; $\frac{1}{3}$ *n. s.*

Family VII. Cancerida.

Pirimela (Leach). Carapace nearly as long as broad, convex, with strongly marked ridges, front margin strongly toothed.

P. denticulata. Fig. 309; *n. s.*

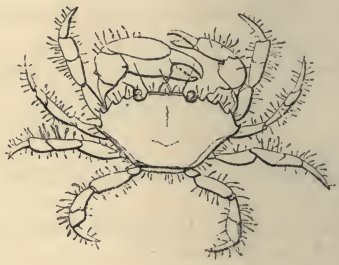
309 311



313 312

Pilumnus (Leach). Carapace much broader than long, four-sided, front margin arched, and bent downwards, surface even.

P. hirtellus. Fig. 310; *n. s.*



310

Xantho (Leach). Carapace broad, slightly convex longitudinally; front margin semi-oval, notched with few blunt teeth: first feet very stout, all the rest small and short.

X. florida. Fig. 311; $\frac{2}{5}$ *n. s.*
rivulosa.
tuberculata.

Cancer (Linn.). Carapace very broad, nearly oval, elevated in the middle; edge on each side notched with ten square, close-set teeth; first feet stout, the rest moderate.

C. pagurus. Fig. 312; $\frac{1}{10}$ *n. s.*

Family VIII. Parthenopidæ.

Eurynome (Leach). Carapace lozenge-form, with a prominent cleft beak; eyes retractile; whole body and limbs covered with spines and knobs.

E. aspera. Fig. 313; *n. s.*

Family IX. Maiadæ.

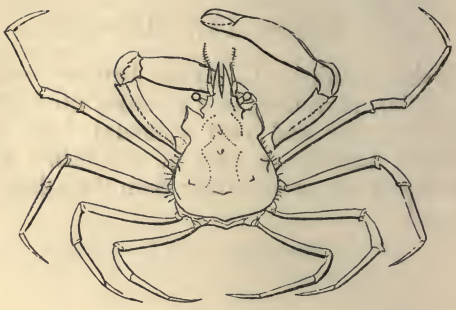
Maia (Lamk.). Carapace between round and triangular, projecting into a double diverging stout beak; convex and very spinous: base of outer antennæ forming a part of the orbit: first feet scarcely or not at all larger than the others; claws pointed.

M. Squinado. Fig. 314; $\frac{1}{8}$ *n. s.*

314

Hyas (Leach). Carapace heart-shaped, broad and rounded behind, with a double, converging, thin beak; a large, almost insulated tooth outside each eye; outer antennæ with the base inserted into the base of the beak, and the second joint dilated: first feet moderately stout, short.

H. araneus.
coarctatus. Fig. 315; $\frac{1}{2}$ *n. s.*



315

Pisa (Leach). Carapace triangular, rounded behind, with a double stout beak, the two portions of which diverge from the middle; a strong triangular spine over each eye; second joint of outer antennæ slender; claws large in the male.

P. tetraodon. Fig. 316; $\frac{1}{2}$ *n. s.*
Gibbsii.

316

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Family X. Leptopodiadæ.

Inachus (Fabr.). Carapace heart-shaped, with a short notched beak; eyes retractile, or capable of being hidden in the orbit; first feet thick, twice as long (in the male) as the body; second pair much longer, the rest diminishing gradually.

I. Dorsettensis. Fig. 317; *n. s.*
Dorynchus.
leptochirus.

317

Achæus (Leach). Carapace and beak as in *Inachus;* eyes not retractile, and incapable of being folded back; feet little longer than body; toes of fourth and fifth pair much curved.

A. Cranchii. Fig. 318; *n. s.*

Stenorhynchus (Lamk.). Carapace triangular, projecting into a long, slender, split beak, the points of which are in contact; first feet long,

318

stout, with the hand swollen; all the others very long and slender; the second pair longest; eye-stalks short.

S. phalangium.
tenuirostris. Fig. 319; *n. s.*

319

Class V. CIRRIPEDIA.

(Barnacles.)

At first sight no two objects can well be more unlike than a Barnacle and a Shrimp. The former is enclosed in a true shell composed of many pieces united either by shelly matter or by cartilage, which allow of the protrusion and retraction of a hand of fine hairy filaments, the whole permanently affixed to foreign objects either by a thick, flexible stalk, or by a broad, immoveable base. The older naturalists associated these animals with the shell-bearing Mollusca, calling them *Multivalves*, and even up to very recent times they have been considered as equally allied to the Sub-Kingdom just named and to that in which they occur here. Mr. Charles Darwin, however, in his admirable Monograph, has fully demonstrated the close affinity which subsists between them and the Crustacea, of which he, indeed, considers them only a subdivision. I prefer, however, to treat them as a Class by themselves, believing that the diversity between the groups is quite as great as that which subsists between the Crustacea and the Arachnida, or between the Arachnida and the Insecta.

The Barnacle begins life in a form exactly like that of a young Entomostracous Crustacean, with a broad carapace, a single eye, two pairs of antennæ, three pairs of jointed, branched, and well-bristled legs, and a forked tail. It casts off its skin twice,

undergoing, especially at the second moult, a considerable change of figure. At the third moult it has assumed almost the form of a *Cypris* or *Cythere*, being inclosed in a bivalve shell, in which the front of the head with the antennæ is greatly developed, equalling in bulk all the rest of the body. The single eye has become two, which are very large, and attached to the outer arms of two bent processes like the letters **U U**, which are seen within the thorax.

In this stage the little animal searches about for some suitable spot for permanent residence; a ship's bottom, a piece of floating timber, the back of a whale or turtle, or the solid rock. When its selection is made, the two antennæ, which project from the shell, pour out a glutinous gum or cement, which hardens in water, and firmly attaches them. Henceforth the animal is a fixture, glued by the front of its head to its support. Another moult now takes place; the bivalve shell is thrown off, with the great eyes, and their **U**-like processes, and the little Cirriped is seen in its true form. It is now in effect a Stomapod Crustacean, attached by its antennæ, the head greatly lengthened (in *Lepas*, &c.), the carapace composed of several pieces (valves) presently to be described, the legs modified into cirri, and made to execute their grasping movements backwards instead of forwards, and the whole abdomen obliterated, or reduced to an inconspicuous rudiment.

As the several valves of which the carapace is formed furnish important characters for discriminating the genera, it will be necessary to name and to explain them. In the stalked or true Barnacles (*Lepadidæ*), in which the carapace is seated

at the end of a stem (*peduncle*) more or less flexible, we see the sides principally composed of two pairs of angular pieces, each pair placed face to face, and opening a little down one edge, while a keeled piece unites them along the opposite edge. The upper pair of opening valves are the *terga*, the lower pair the *scuta*, and the keeled piece behind is the *carina*. A small valve at the lower part of the front edge, between the *scuta*, is the *rostrum*, and there is sometimes a second piece below this, called the *sub-rostrum*. Other valves around the lower part, or between the *scuta* and the *carina*, are called *latera*, or lateral valves; and they are named *rostral*, *carinal*, *upper*, or *median latera*, according to their position. Similar adjectives, distinguishing the several *margins* of the valves, as the *rostral margin*, &c., are given for the same reason; and the margins of the *scuta* and *terga* which border the opening are the *occludent* margins. The *scuta* and *terga* are called *opercular valves;* and are moveable when all the other valves are immoveable, by means of powerful muscles attached to their interior surface.

The sessile or stalkless Barnacles, or Acorn-shells (*Balanidæ*), appear to differ much in the formation of their shells from the *Lepadidæ*, but the diversity is produced by modification of the same essential valves. The *scuta* and *terga* are placed within the other valves (which are soldered, as it were, into a conical shell), and move up and down in the orifice. The cone itself is resolved into valves, some of which are much more developed than in the stalked species. In a completely developed form, the valves of the cone are eight in number, of which the one *from* which the

movement of the cirri is made, is the *carina*, and the opposite one the *rostrum;* the three intermediate ones on each side are the *carino-lateral*, the *lateral*, and the *rostro-lateral* valves. Each valve consists of a central portion called the *wall*, and a portion on each side, which may be either *radii* or *alæ*, or an *ala* on one side and a *radius* on the other. These may be distinguished by the circumstance, that in the overlapping of the parts, the *radius* is always outside the *ala*.*

These terms are very technical, but they are necessary for the discrimination of the Barnacles, which from their nature present peculiar difficulties; and even when theoretical knowledge is perfect, in many cases it cannot be applied without considerable trouble; the *Balanidæ* often having their valves so firmly soldered together, that the distinction of *radius* and *ala* is altogether obliterated. In this case, the specimen must be immersed in a boiling solution of caustic potass, when, the animal matter being dissolved away, the valves will separate, and their constituent parts may be recognised.

Nothing can be conceived more effective, or more beautiful, than the manner in which a Cirriped obtains its prey. Its food, as Professor Rymer Jones observes, consists of various minute animals, "caught in the water around them by a mechanism at once simple and elegant. Any one who watches the movements of a living Cirriped, will perceive that its arms, with their appended *cirri*, are in perpetual movement, being alternately thrown out and retracted with great rapidity; and that, when fully expanded, the plumose and flexi-

* Darwin's "Monograph of Cirripedia."

ble stems form an exquisitely beautiful apparatus, admirably adapted to entangle any nutritious atoms, or minute living creatures, that may happen to be present in the circumscribed space over which this singular casting-net is thrown, and drag them down into the vicinity of the mouth, where, being seized by the jaws, they are crushed and prepared for digestion. No sense but that of touch is required for the success of this singular mode of fishing; and the delicacy with which the tentacles perceive the slightest contact of a foreign body, shows that they are eminently sensible to tactile impressions." *

Authority, Identification, Localities, &c.

The paramount *authority* on all subjects connected with the Class is Mr. Darwin's "Monograph" above cited; from whom I have given sufficient directions for *identification* of specimens; while *localities* and habits will be indicated in detail.

CIRRIPEDIA.

Cemented to other bodies by the head. Archetype composed of seventeen segments, the first three of which are large, and almost wholly developed into a carapace, [*i.e.* the valves and stalk,] not wholly sloughed, and capable of various movements; antennæ none in the adult state; eyes rudimentary; mouth prominent; thorax attached to the internal surface of the carapace, generally bearing six pairs of two-branched, many-jointed limbs, which are thrown out to capture prey;

* General Outline, p. 356.

abdomen generally rudimentary; gills, when present, attached to the under sides of the carapace; the sexes generally distinct; the males rudimentary and parasitic on the female; metamorphosis complex.

Sessile:	
Shell symmetrical; scuta and terga furnished with depressor muscles; the other valves united immoveably . . .	*Balanidæ.*
Shell unsymmetrical; scuta and terga moveable only on one side, united on the other side to the external valves .	*Verrucadæ.*
Stalked	*Lepadidæ.*

Family I. Balanidæ.

Rostrum with radii, without alæ; lateral valves with alæ on one side, and radii on the other; walls generally porous or internally ridged	*Balaninæ.*
Rostrum with alæ, without radii; rostro-lateral valves without alæ; walls not porous	*Chthamalinæ.*

Sub-Family I. Balaninæ.

Balanus (Ellis). Shell-valves six; opercular valves sub-triangular.

B. spongicola.	B. crenatus.
perforatus.	balanoides.
improvisus.	Hameri.
porcatus. Fig. 320; *n. s.*	

Acasta (Leach). Shell-valves six; walls and base not porous; base calcareous, cup-shaped; affixed to sponges, or to the *Isis* corals.

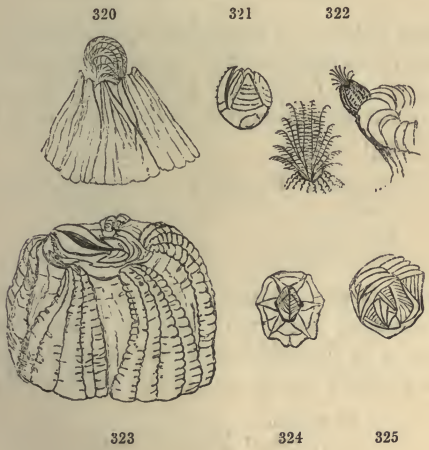
A. spongites. Fig. 321; *n. s.*

Pyrgoma (Leach). Shell-valves united into one; base cup-shaped, or sub-cylindrical; affixed to corals.

P. Anglicum. Fig. 322; *n. s.* and *mag.*

Coronula (Lamk.). Shell-valves equal; walls thin, deeply folded; opercular valves smaller than orifice, affixed to living *Cetacea.*

C. diadema. Fig. 323; ½ *n. s.*



Sub-Family II. Chthamalinæ.

Chthamalus (Ranzani). Shell-valves six; base membranous, but sometimes apparently calcareous, owing to the walls being bent inwards.

C. stellatus. Fig. 324; *n. s.*

Family II. Verrucadæ.

Verruca (Schumacher). Opercular valves not furnished with depressor muscles, united immoveably on one side with the shell-valves into an unsymmetrical shell.

V. Strömia. Fig. 325; *n. s.*

Family III. Lepadidæ.

Lepas (Linn.). Valves five, approaching; carina extending up between the terga, terminating downwards in an imbedded fork, or in an external disk; scuta sub-triangular, with their beaks at the rostral angle.

L. anatifera. Fig. 326; *n. s.* (*one-half of the carapace removed.*)
Hillii.
pectinata.
fascicularis.

Conchoderma (Olfers). Valves two to five, minute, remote; scuta with two or three lobes, with the beaks in the middle of the occludent margin; carina arched, upper and lower ends nearly alike.

C. aurita.
virgata. Fig. 327; *n. s.*

Anelasma (Darwin). Without valves; aperture large; peduncle fringed, sub-globular, imbedded.

A. squalicola (on Sharks). Fig. 328; *n. s.*

Alcippe (Hancock). Without valves; aperture spinous; peduncle growing at the base; rostral surface depressed and covered by a horny disk;

the whole imbedded in a cavity excavated in shells of Mollusks.

A. lampas. Fig. 329; *mag.* $\frac{4}{1}$.

Scalpellum (Leach). Valves twelve to fifteen; latera of the lower whorl four or six; sub-rostrum rarely present; peduncle scaly. Male minute, parasitic near the orifice.

S. vulgare. Fig. 330; *n. s.*

Pollicipes (Leach). Valves from eighteen to one hundred and upwards; latera of lower whorl numerous; sub-rostrum always present; peduncle scaly.

P. cornucopia. Fig. 331; *n. s.*

Class VI. ARACHNIDA.

(Mites.)

This Class includes Spiders, Scorpions and Mites; of which, numerous as they are, no species was known to inhabit the British seas until the discovery, a few years ago, by Professor Allman, of a Mite living parasitically within the nostrils of a seal. I have just added two species, still more minute, and constituting a new genus, to our list of marine Arachnida. The latter are both found crawling about sea-weeds at extreme low-water.

The Class is for the most part composed of terrestrial animals; but in the Order *Acarina*, to which the three marine species above mentioned belong, there is a large group which is aquatic; and many of them are sufficiently common in our fresh-waters.

The Arachnida are distinguished by having four pairs of jointed legs, by breathing air either by lungs inclosed in bags, or by radiating pipes (*tracheæ*), which communicate with the exterior by means of slits (*spiracles*) on the surface of the body, and by the concentration of their nervous system. They have no antennæ, and no compound eyes; their head and thorax are generally so united as to be indistinguishable, but the abdomen is generally separate. They are all carnivorous, and many of them highly endowed with instincts and powers for preying on other animals.

The Mites are generally very minute, and many are parasites upon larger animals.

Order ACARINA.

Breathing by radiating air-pipes, which open by two spiracles. Body undivided, or only superficially divided into thorax and abdomen. Mouth forming a beak or sucker with lancet-like jaws, and palpi (feelers) which are either clawed or fanged.

Halarachne (Allman). Palpi free, thread-shaped; jaws two-clawed; legs with the last joint terminated by two hooks, and an intermediate three-lobed wart; body entire, lengthened, sub-cylindrical, furnished with a dorsal plate in front; eyes none.

H. halichœri. Fig. 332; *mag.* $\frac{6}{1}$.

Halacarus (Gosse). Body covered above with a shield; beak bulbous, pointed; palpi tipped with a fang-like claw; feet formed for walking, directed two pairs forward and two backward, tipped with a pair of hooks; thighs remote from each other.

H. rhodostigma. Fig. 333; *mag.* $\frac{36}{1}$.
ctenopus.

332

333

Class VII. INSECTA.

(Insects.)

Though this is, beyond all comparison, the most populous Class of animals, embracing as it does more than ten times as many species as all other living beings put together, the sea is singularly destitute of them. It has been frequently said that no true Insect is marine; and though this is not literally true, the minuteness of the exception makes the rule even more striking than it would have been if absolutely universal. Of the hundreds of thousands of Insects known to exist, but *two* live in the sea, and both of these may be found on our own coasts. Both are Beetles, distinguished from other Insects by having jaws, and a pair of membranous wings folded and concealed under a pair which assume the form of leathery sheaths, meeting in a straight line along the middle of the back, but not overlapping.

The habits of these two little species, neither of which exceeds an eighth of an inch in length, are alike. They haunt under stones at the verge of low-water, and are consequently covered by the tide for many hours every day, and at the time of neap-tides are not exposed even for several successive days. It is believed that the air which they need for breathing is entangled among the pebbles

under which they live; but it is probable that they frequently come to the surface to breathe, like the *Dyticidæ* and others of our fresh-water Beetles.

There is, however, besides these, the larva of some two-winged fly, which is marine. I have repeatedly taken it on our southern shores, quite out of the influence of fresh water. It was probably this larva (which is white, and half-an-inch in length) that Dr. Johnston described as an Annelid, by the name of *Campontia eruciformis* ("Zool. Journ." iii. 325). That my specimens are those of a Dipterous larva, I have the high authority of Mr. Francis Walker, who examined one.

Insecta.

Three pairs of jointed legs; one pair of antennæ; body divided into head, thorax, and abdomen; breathing performed by two parallel air-pipes, opening by numerous spiracles on each side; undergoing complex metamorphosis.

Order COLEOPTERA.

Two pairs of wings, the fore pair having the form and office of stiff leathery sheaths for the second; two pairs of jaws.

Tribe I. Carabici.

Lower jaws (*maxillæ*) simply hooked at the tip, not jointed at the base, two feelers (*palpi*) to each *maxilla;* antennæ thread-like; wing-sheaths covering the abdomen, which is covered above with a thin skin.

Aepus (Leach). Head large; eyes minute; wing-sheaths flattened; upper jaws projecting, many-toothed.

A. marinus. Fig. 334; *mag.* $\frac{5}{1}$.

Tribe II. Brachelytra.

One feeler to each maxilla; antennæ thickening towards the tip; wing-sheaths much shorter than the abdomen, which is covered with a horny crust.

Micralymma (Westwood). Oblong, depressed; wing-sheaths very small; abdomen long, much broader than thorax, margined; foot-joints (*tarsi*) fringed with long hairs.

M. brevipenne. Fig. 335; *mag.* $\frac{6}{1}$.

334

335

The Student will please to observe the following Notes.

1. For simplicity, I have occasionally omitted in the definition of families, genera, &c., those characters which are not needful in the discrimination of *British* specimens.

2. Species occasionally occur in which some one or more of the generic characters are wanting, while yet the preponderance of characters shows it to be rightly located. Nature will not bend to our systems.

3. In general, a character once given must be understood as belonging also to following genera *in the same family,* until it is distinctly contradicted or modified.

4. The mark (?) placed before the name or initial of the *genus,* indicates an uncertainty whether the species truly belongs to that genus.

5. The mark (?) placed after the name of a *species* indicates that there is some doubt whether the specimen or specimens found on the British shores really belonged to that species.

6. The proper name set after the name of each genus is the name of the naturalist who first defined its characters.

7. The mark = signifies "equivalent to," or "synonymous with;" and is used when a generic

name has, through mistake, obtained a measure of notoriety not due to it.

8. The letters and fractional numbers frequently set after the references to the figures, indicate the ratio which the figures bear to the size of nature: thus *n. s.* signifies "natural size;" $\frac{1}{5}$, that the figure is one-fifth of natural size; and $\frac{10}{1}$, that it is magnified ten times.

9. For all hard names, look first for an explanation in the notes with which each Class is introduced; if it is not explained there, search for it in the Glossary.

10. Finally, do not be discouraged if you meet with difficulties; whatever is worth attaining is worth persevering for; there is no royal road to science. It would be well to practise upon some common animal whose name you already know; for example, the Prawn (*Palæmon*), the Lobster (*Homarus*), the Crab (*Cancer*), the common Smooth Anemone (*Actinia*), the Sea-urchin (*Echinus*). Take either of these, and compare it with the characters given of its Class, its Order, its Family, its Genus:—you will not recognise all, but you will find enough to afford you very useful practice, and to increase your experimental acquaintance with Zoology.

GLOSSARY

OF TECHNICAL TERMS IN PART I.

Aciculi (page 99). In certain worms,—straight, flat, taper, brown, horny bristles, contained in the foot, and not protruded like the proper bristles.

Anastomosing (p. 5). When fibres or tubes approach each other at intervals and unite, forming an irregular network, they are said to *anastomose.*

Annular (p. 26). Forming a ring.

Antennæ (p. 100, &c.). Jointed threads proceeding from the head.

Archetype (p. 171). The perfect representative of a particular form, perhaps existing only in theory.

Articulated (p. 58, &c.). Jointed, either in its parts or to some other part.

Bilateral (p. 78). Having a right and a left side.

Branchial (p. 130). Belonging to, or serving as gills (*branchiæ*).

Calcareous (p. 6). Formed of lime.

Capsules (p. 17). Bladder-like vessels.

Capsuliferous (p. 28). Carrying capsules.

Cellular (p. 76). Formed of large cells.

Cilia (p. 2, &c). Minute lashing or vibrating hairs.

Ciliated. Furnished with *cilia.* But the term is sometimes applied, among CRUSTACEA, &c. (see p. 125), to organs which are fringed with stiff bristles, which are not vibrating.

Cirri (p. 64). Fleshy unjointed threads. In the CIRRIPEDIA (p. 168), the term means curled, jointed, fringed limbs.

Compressed. Flattened sidewise. (See *depressed*).

Convoluted (p. 42). Rolled up, like a scroll.

Corallum (p. 20). The solid parts of a Polype, whether external or internal.

Coriaceous (p. 32). Resembling leather.

Deciduous (p. 18). Falling off at a certain period.

Depressed. Flattened from above. A Thornback is *depressed*, a Dory *compressed*.

Dextral (p. 95). In shells—turning from east to south.

Dichotomous (p. 47). Dividing into two branches, each of these again into two, and so on.

Ditrematous (p. 26). Having two openings — the mouth and the vent separate.

Dorsal (p. 63). Belonging to the back, or upper side.

Entire (p. 62). Not notched, or lobed at the margin.

Epidermic (p. 34). Belonging to the outer skin (*epidermis*).

Evertile (p. 96). Capable of turning inside-out.

Extensile (p. 19). Capable of lengthening.

Filament (p. 50). A slender thread.

Fissures (p. 81). Slits in the head of certain worms, for breathing.

Frontal (p. 80). Placed on the front.

Gelatinous (p. 8). Resembling jelly.

Gregarious (p. 19). Associating in numbers together.

Homogeneous (p. 22). Of but one substance.

Linear (p. 34). Very long and slender, like a line.

Lobe (p. 28). A rounded projection from the common outline.

Longitudinal (p. 66). Arranged lengthwise.

Metamorphosis (p. 41). Such an alteration of form as takes place when a caterpillar becomes in succession a chrysalis and a butterfly.

Monotrematous (p. 26). Having but one opening to the body, serving both for mouth and vent.

Natatory (p. 130). Serving for swimming.

Normal (p. 26). Ordinary; as it usually appears.

Operculum (p. 92). Anything that shuts up an opening.

Oral (p. 50). Belonging to the mouth.

Orbit (p. 163). The hollow in which the eye is set.

Ovate (p. 11). Somewhat oval.

Parasitic (p. 22). Living habitually on other animals.

Pectinated (p. 99). Set like the teeth of a comb.

Pelotonnement, par (p. 11). As cotton is rolled on a reel.

Pinnæ (p. 34). Processes set in two rows, like the beards of a feather, or the leaflets of a rose.

Prehensile (p. 122). Capable of catching hold.

Radiate (p. 17). Having the organs arranged like the spokes of a wheel, around a centre.

Reticulated (p. 67). Forming a network.

Respiratory (p. 81). Formed for breathing.

Retractile (p. 20). Capable of being withdrawn, like the horns of a snail.

Sac (p. 48). A bag.

Sessile (p. 18). Without foot-stalks.

Siliceous (p. 25). Formed of flint.

Sinistral (p. 95). In shells—turning from east to north.

Spherules (p. 29). Bodies of globular form.

Styles (p. 100). Stiff unjointed processes, tapering to a point.

Sub- (p. 32, &c.). Almost or somewhat.

Suture (p. 27). A mark or seam, where two edges have united.

Tentacles (p. 15, &c.). Slender, contractile, unjointed organs, placed near the mouth.

Tentacular (p. 100). Resembling tentacles.

Terminal (p. 19). Placed at the extremity.

Tissues (p. 17). The soft substances which make up a living body.

Transverse (p. 67). Placed across, from right to left.

Truncate (p. 26). Terminating abruptly, as if the tip had been cut off.

Umbilical (p. 12). Next to the *umbilicus*, or the depression in the centre of a shell, around which its spire winds.

Vesicle (p. 18). A small bladder or bag.

Vibratile (p. 76). Capable of rapid motion to and fro.

Viscera (p. 76). Internal soft organs, necessary to the maintenance of life.

List of Illustrations:

(WITH THE AUTHORITIES WHENCE DERIVED.)

Fig.

1. Tethea cranium (½ *nat. size*) . . . . Johnston.
2. Geodia Zetlandica (*magnified*) . . . . Ibid.
3. Pachymatisma Johnstonia (spicula *mag.*) Ibid.
4. Halichondria panicea (*n. s.*) . . . . . Living specimen.
5. Cliona gorgonioides (*n. s.*) . . . . . Hancock.
5*. Spongia limbata (*n. s.*) . . . . . Johnston.
6. Dysidea papillosa (*n. s.*) . . . . . Ibid.
7. Halisarca Dujardinii (*n. s.*) . . . . . Ibid.
8. Grantia compressa (*n. s.*) . . . . . Living specimen.
9. Lagena striata (*mag.*) . . . . . Williamson.
10. Entosolenia marginata (section *mag.*) . . Ibid.
11. Dentalina recta (*mag.*) . . . . . Montagu.
12. Nonionina crassula (*mag.*) . . . . . Ibid.
13. Rotalina Beccarii (*mag.*) . . . . . Specimen.
14. Polystomella crispa (*mag.*) . . . . . Living specimen.
15. Globigerina inflata (*mag.*) . . . . . Montagu.
16. Polymorphina oblonga (*mag.*) . . . . Brown.
17. Spiroloculina concentrica (*mag.*) . . . Specimen.
18. Quinqueloculina subrotunda (*mag.*) . . Walker.
19. Triloculina oblonga (*mag.*) . . . . . Montagu.
20. Truncatulina lobatula (*mag.*) . . . . D'Orbigny.
21. Noctiluca miliaris (*mag.*) . . . . . Living specimen.
22. Adelosina bicornis (*mag.*) . . . . . Walker.
23. Clava multicornis (*n. s.* & *mag.*) . . . Living specimen.
24. Hydractinia echinata (*mag.*) . . . . . Ibid.
25. Myriothela arctica (*n. s.*) . . . . . Ibid.
26. Coryne sessilis (*mag.*) . . . . . Ibid.

Fig.
27. Eudendrium ramosum (*n. s.* & *mag.*) . . Johnston.
28. Tubularia indivisa (*mag.*) . . . . . Ibid.
29. Corymorpha nutans (*n. s.*) . . . . . Ibid.
30. Halecium halecinum (*n. s.* & *mag.*) . . Ibid.
31. Sertularia abietina (*n. s.* & *mag.*) . . . Ibid.
31*. Reticularia immersa (*mag.*) . . . . . Wy. Thompson.
31**. Coppinia arcta (*mag.*) . . . . . Ibid.
32. Thuiaria thuia (*n. s.* & *mag.*) . . . . Johnston.
33. Antennularia antennina . . . . . Living specimen.
34. Plumularia pinnata (*n. s.* & *mag.*) . . Ibid.
35. Laomedea geniculata (*n. s.* & *mag.*) . . Ibid.
36. Campanularia volubilis (*n. s.* & *mag.*) . . Ibid.
37. Anthea cereus (*n. s.*) . . . . . Ibid.
38. Adamsia palliata (*n. s.*) . . . . . Ibid.
39. Corynactis Allmanni (*n. s.*) . . . . . Ibid.
40. Capnea sanguinea (*n. s.*) . . . . . Forbes.
41. Sagartia bellis (*n. s.*) . . . . . Living specimen.
42. Bunodes crassicornis (*n. s.*) . . . . . Ibid.
43. Actinia mesembryanthemum (*n. s.*) . . Ibid.
44. Ilyanthus Mitchelli (*n. s.*) . . . . . Ibid.
44*. Arachnactis albida (*n. s.*) . . . . . Forbes.
45. Edwardsia callimorpha (*n. s.*) . . . . Living specimen.
46. Peachia hastata (½ *n. s.*) . . . . . Ibid.
47. Lucernaria auricula (*n. s.*) . . . . . Ibid.
48. Zoanthus Couchii (*n. s.*) . . . . . Johnston.
49. Turbinalia milletiana (*n. s.*) . . . . . Specimen.
50. Cyathina Smithii (*n. s.*) . . . . . Living specimen.
51. Balanophyllea regia (*n. s.*) . . . . . Ibid.
52. Oculina prolifera (*n. s.*) . . . . . Specimen.
53. Pennatula phosphorea (*n. s.*) . . . . . De Blainville.
54. Virgularia mirabilis (¼ *n. s.*; & a part *n. s.*) Müller.
55. Pavonaria quadrangularis (*diminished*) . Forbes.
56. Alcyonium digitatum (*n. s.*; & a polype *mag.*) Living specimen.
57. Sarcodictyon catenata (*n. s.*) . . . . . Specimen.
58. Gorgonia verrucosa (*n. s.*) . . . . . Ibid.
59. Primnoa lepadifera (*n. s.*) . . . . . Ibid.
60. Sarsia tubulosa (*n. s.*) . . . . . Living specimen.
60*. Plancia gracilis (*n. s.*) . . . . . Forbes.

Fig.
61. Bougainvillæa Britannica (*n. s.*) . . . Forbes.
62. Lizzia octopunctata (*n. s.*) . . . . . Ibid.
63. Modceria formosa (*n. s.*) . . . . . Ibid.
64. Euphysa aurata (*n. s.*) . . . . . Ibid.
65. Steenstrupia flaveola (*n. s.*) . . . . . Ibid.
66. Geryonia appendiculata (*n. s.*) . . . . Ibid.
67. Tima Bairdii ($\frac{1}{8}$ *n. s.*) . . . . . Ibid.
68. Geryonopsis delicatula ($\frac{1}{2}$ *n. s.*) . . . . Ibid.
69. Thaumantias Buskiana (*n. s.*) . . . . Living specimen.
70. Slabberia halterata (*n. s.*) . . . . . Forbes.
71. Turris neglecta (*n. s.*) . . . . . Living specimen.
72. Saphenia Titania (*mag.*) . . . . . Ibid.
73. Oceania pusilla (*mag.*) . . . . . Ibid.
74. Circe rosea (*n. s.*) . . . . . Forbes.
75. Stomobrachium octocostatum (*n. s.*) . . Ibid.
76. Polyxenia Alderi (*n. s.*) . . . . . Ibid.
77. Æquorea Forbesiana ($\frac{1}{2}$ *n. s.*) . . . . . Living specimen.
78. Willsia stellata (*mag.*) . . . . . Ibid.
79. Medusa aurita ($\frac{1}{4}$ *n. s.*) . . . . . Cuvier.
80. Cyanæa capillata ($\frac{1}{15}$ *n. s.*) . . . . . Barbut.
81. Chrysaora cyclonota ($\frac{1}{2}$ *n. s.*) . . . . Living specimen.
82. Pelagia cyanella ($\frac{2}{3}$ *n. s.*) . . . . . Ibid.
83. Cassiopea lunulata ($\frac{1}{14}$ *n. s.*) . . . . Borlase.
84. Rhizostoma pulmo ($\frac{1}{12}$ *n. s.*) . . . . Living specimen.
85. Cydippe pomiformis (*n. s.*) . . . . . Ibid.
86. Bolina hibernica ($\frac{1}{5}$ *n. s.*) . . . . . Patterson.
87. Beroe fulgens? (*n. s.*) . . . . . Living specimen.
88. Alcinoe vermiculata ($\frac{1}{2}$ *n. s.*) . . . . Lesson.
89. Diphyes campanulifera? (*mag.*) . . . . Peach.
90. Physalia pelagica ($\frac{1}{4}$ *n. s.*) . . . . . Lesson.
91. Velella vulgaris (*n. s.*) . . . . . Specimen.
92. Rataria pocillum (*n. s.*) . . . . . Montagu.
93. Comatula rosacea ($\frac{1}{2}$ *n. s.*) . . . . . Specimen.
95. Ophiura albida (*n. s.*) . . . . . Living specimen.
96. Ophiocoma rosula (*n. s.*) . . . . . Ibid.
97. Astrophyton scutatum ($\frac{1}{3}$ *n. s.*) . . . Specimen.
98. Uraster rubens ($\frac{1}{10}$ *n. s.*) . . . . . Living specimen.
99. Cribella oculata ($\frac{1}{4}$ *n. s.*) . . . . . Ibid.

Fig.
100. Solaster papposa ($\frac{1}{4}$ *n. s.*) . . . . . Living specimen.
101. Palmipes membranaceus ($\frac{1}{3}$ *n. s.*) . . Ibid.
102. Asterina gibbosa ($\frac{2}{3}$ *n. s.*) . . . . . Specimen.
103. Goniaster Templetoni ($\frac{1}{3}$ *n. s.*) . . . Ibid.
104. Asterias aurantiaca ($\frac{1}{4}$ *n. s.*) . . . . Ibid.
105. Luidia fragilissima ($\frac{1}{24}$ *n. s.*) . . . . Forbes.
106. Cydaris papillata (*n. s.*) . . . . . Specimen.
107. Echinus sphæra ($\frac{1}{2}$ *n. s.*) . . . . . Living specimen.
108. Echinocyamus pusillus (*n. s.*) . . . . Specimen.
109. Echinarachius placenta ($\frac{1}{4}$ *n. s.*) . . . Ibid.
110. Spatangus purpureus ($\frac{1}{4}$ *n. s.*) . . . . Ibid.
111. Brissus lyrifer ($\frac{1}{2}$ *n. s.*) . . . . . Ibid.
112. Amphidotus cordatus ($\frac{1}{2}$ *n. s.*) . . . . Ibid.
113. Pentacta pentactes ($\frac{1}{2}$ *n. s.*) . . . . . Living specimen.
114. Ocnus brunneus (*n. s.*) . . . . . Ibid.
115. Psolinus brevis (*mag.*) . . . . . Forbes.
116. Thyone papillosa (*n. s.*) . . . . . Ibid.
116*a*. Holothuria nigra ($\frac{1}{5}$ *n. s.*) . . . . . Peach.
117. Psolus phantapus ($\frac{1}{4}$ *n. s.*) . . . . . Forbes.
118. Chirodota digitata ($\frac{1}{2}$ *n. s.*) . . . . . Specimen.
119. Syrinx nudus ($\frac{1}{3}$ *n. s.*) . . . . . Ibid.
120. Sipunculus punctatissimus (*n. s.*) . . . Living specimen.
121. Priapulus caudatus ($\frac{1}{3}$ *n. s.*) . . . . . Forbes.
122. Thalassema Neptuni (*n. s.*) . . . . . Montagu.
123. Echiurus oxyurus ($\frac{1}{5}$ *n. s.*) . . . . . Forbes.
124. Eurylepta vittata (*n. s.*) . . . . . Montagu.
125. Leptoplana tremellaris (*n. s.*; & head *mag.*) . . . . . Living specimen.
126. Planaria flexilis (*n. s.*) . . . . . Quatrefages.
127. Convoluta paradoxa (*mag.*) . . . . . Living specimen.
128. Astemma rufifrons (*n. s.*; & head *mag.*) . Ibid.
129. Tetrastemma quadrioculatum (*n. s.* & head *mag.*). . . . . Ibid.
130. Polystemma roseum (*n. s.*; & head *mag.*) Ibid.
131. Nemertes Borlasii (*n. s.*) . . . . . Ibid.
132. Serpentaria fragilis (*dimin.*) . . . . Goodsir.
133. Udonella caligorum (*mag.*) . . . . Johnston.
134. Malacobdella grossa (*n. s.*) . . . . . Müller.

Fig.
135. Tristoma molæ (*n. s.*) . . . . . Blanchard.
136. Phylline hippoglossi (*n. s.*) . . . . . Johnston.
137. Piscicola marina (*n. s.*) . . . . . Moquin-Tandon.
138. Pontobdella muricata (*n. s.*) . . . . Ibid.
139. Nephelis octoculata (*n. s.*) . . . . . Ibid.
140. Glossiphonia Euchana (*n. s.*) . . . . Thompson.
141. Monopus medusicola (*mag.*) . . . . Living specimen.
142. Pectinaria Belgica (*n. s.*) . . . . . Müller.
143. Sabellaria alveolata (*n. s.*) . . . . . Living specimen.
144. Siphonostoma vestitum (*n. s.*) . . . . Ibid.
145. Flemingia plumosa (*n. s.*) . . . . . Johnston.
146. Terebella conchilega? (*n. s.*) . . . . Living specimen.
147. Othonia Johnstoni (*mag.*) . . . . . Ibid.
148. Sabella tubularia (*n. s.*) . . . . . Ibid.
149. Serpula contortuplicata (*n. s.*) . . . . Ibid.
150. Spirorbis communis (*mag.*) . . . . Ibid.
151. Filograna implexa (*n. s.*) . . . . . Plancus.
152. Ditrupa subulata (*mag.*) . . . . . Montagu.
153. Lumbricus capitatus (*n. s.*; & head *mag.*) Johnston.
154. Arenicola piscatorum (½ *n. s.*) . . . . Living specimen.
155. Travisia Forbesii (*n. s.*) . . . . . Johnston.
156. Nerine coniocephala (⅔ *n. s.*) . . . . Ibid.
157. Spio seticornis (*mag.*) . . . . . Living specimen.
158. Leucodore ciliatus (*mag.*) . . . . . Johnston.
159. Cirratulus medusa (*n. s.*) . . . . . Living specimen.
160. Derris sanguinea (*n. s.* & *mag.*) . . . Adams.
161. Branchiarius quadrangulatus (*n. s.*) . . Montagu.
162. Diplotes hyalina (*mag.*) . . . . . Ibid.
163. Glycera alba (*n. s.* & *mag.*) . . . . Johnston.
164. Pollicera peripatus (*n. s.* & *mag.*) . . Ibid.
165. Nephtys margaritacea (*n. s.*) . . . . Living specimen.
166. Ioida macrophthalma (*n. s.* & *mag.*) . Johnston.
167. Psamathe fusca (*n. s.* & *mag.*) . . . Ibid.
168. Phyllodoce viridis (*n. s.* & *mag.*) . . Living specimen.
169. Myriana pennigera (*n. s.* & *mag.*) . . Montagu.
170. Syllis longiseta (*mag.*) . . . . . Living specimen.
171. Nereis versicolor (*n. s.*) . . . . . Ibid.
172. Lysidice Ninetta (*n. s.* & *mag.*) . . . Ibid.

Fig.
173. Onuphis tubicola (*n. s.* & *mag.*) . . . Müller&Johnston.
174. Eunice sanguinea (⅓ *n. s.*) . . . . . Montagu.
175. Euphrosyne foliacea (*n. s.* & *mag.*) . . Specimen.
176. Spinther oniscoides (*mag.*) . . . . . Johnston.
177. Sigalion boa (*n. s.*) . . . . . Living specimen.
178. Pholoe inornata (*n. s.* & *mag.*) . . . Johnston.
179. Polynoe cirrata (*n. s.*) . . . . . Living specimen.
180. Aphrodita aculeata (½ *n. s.*) . . . . Ibid.
181. Tomopteris scolopendra (*mag.*) . . . Ibid.
182. Sagitta bipunctata (*mag.*) . . . . . Ibid.
183. Furcularia marina (*mag.*) . . . . . Ibid.
184. Synchæta Baltica (*mag.*) . . . . . Ibid.
185. Monura coluris (*mag.*) . . . . . Ibid.
186. Colurus caudatus (*mag.*) . . . . . Ibid.
187. Brachionus Mülleri (*mag.*) . . . . . Ibid.
188. Pterodina clypeata (*mag.*) . . . . . Ibid.
189. Pycnogonum littorale (*n. s.*) . . . . Specimen.
190. Phoxichilus spinosus (*mag.*) . . . . Living specimen.
191. Phoxichilidium olivaceum (*n. s.* & *mag.*) Ibid.
192. Pallene brevirostris (*mag.*) . . . . . Johnston.
193. Nymphon gracile (*n. s.* & *mag.*) . . . Living specimen.
194. Lernea branchialis (*n. s.*) . . . . . Specimen.
195. Lerneonema spratta (*n. s.*) . . . . . Ibid.
196. Anchorella uncinata (*mag.*) . . . . Ibid.
197. Lerneopoda galei (*n. s.*) . . . . . Baird.
198. Lernentoma lophii (*n. s.*) . . . . . Specimen.
199. Chondracanthus lophii (*n. s.*) . . . . Ibid.
200. Anthosoma Smithii (*n. s.*) . . . . . Ibid.
201. Nicothoe astaci (*mag.*) . . . . . Baird.
202. Cecrops Latreillii (*n. s.*) . . . . . Specimen.
203. Læmargus muricatus (*n. s.*) . . . . Baird.
204. Pandarus bicolor (*n. s.*) . . . . . Specimen.
205. Dinemoura alata (*n. s.*) . . . . . Baird.
206. Trebius caudatus (*mag.*) . . . . . Specimen.
207. Chalimus scombri (*mag.*) . . . . . Ibid.
208. Lepeoptheirus hippoglossi (*n. s.*) . . . Ibid.
209. Caligus diaphanus (*n. s.*) . . . . . Ibid.
210. Notodelphys ascidicola (*mag.*). . . . . Baird.

Fig.
211. Canthocamptus Strömii (*mag.*) . . . Living specimen.
212. Arpacticus chelifer (*mag.*) . . . . . Ibid.
213. Alteutha depressa (*mag.*) . . . . . Ibid.
214. Temora Finmarchica (*mag.*) . . . . Baird.
215. Anomalocera Pattersonii (*mag.*) . . . Ibid.
216. Cetochilus septentrionalis (*mag.*) . . Specimen.
217. Cypridina Macandrei (*mag.*) . . . . Baird.
218. Cythere reniformis (*mag.*) . . . . . Living specimen.
219. Cythereis Jonesii (*mag.*) . . . . . Baird.
220. Evadne Nordmanni (*mag.*) . . . . . Ibid.
221. Artemia salina (*mag.*) . . . . . Specimen.
222. Nebalia bipes (*mag.*) . . . . . Living specimen.
223. Caprella linearis (*mag.*) . . . . . Ibid.
224. Leptomera pedata (*mag.*) . . . . . Specimen.
225. Cyamus Thompsoni (*mag.*) . . . . . Ibid.
226. Bopyrus squillarum (*n. s.*) . . . . . Ibid.
227. Ione thoracicus (*n. s.*). . . . . M.-Edwards.
228. Phryxus hyppolytes (male) (*n. s.*). . . Rathke.
229. Ibid. (female) (*n. s.*) . . Ibid.
230. Cirolana Cranchii (*n. s.*) . . . . . Specimen.
231. Eurydice pulchra (*mag.*) . . . . . Ibid.
232. Æga bicarinata (*n. s.*). . . . . Ibid.
233. Rocinela monophthalma (*n. s.*) . . . Ibid.
234. Conilera cylindracea (*n. s.*) . . . . . Ibid.
235. Sphæroma serratum (*n. s.*) . . . . . Living specimen.
236. Cymodocea truncata (*n. s.*) . . . . . Specimen.
237. Næsea bidentata (*mag.*) . . . . . Living specimen.
238. Campecopea hirsuta (*mag.*) . . . . . Specimen.
239. Praniza cœruleata (*mag.*) . . . . . Ibid.
240. Anceus maxillaris (*mag.*) . . . . . Ibid.
241. Lygia oceanica (*n. s.*) . . . . . Ibid.
242. Limnoria terebrans (*mag.*) . . . . . Ibid.
243. Jæra albifrons (*mag.*) . . . . . Living specimen.
244. Oniscoda maculosa (*mag.*) . . . . . Specimen.
245. Apseudes talpa (*mag.*) . . . . . Ibid.
246. Tanais Savignyi (*mag.*) . . . . . Living specimen.
247. Idotea tricuspidata (*n. s.*) . . . . . Ibid.
248. Anthura gracilis (*mag.*) . . . . . Ibid.

Fig.
249. Arcturus longicornis (*n. s.*) . . . . . Specimen.
250. Chelura terebrans (*mag.*) . . . . . Ibid.
251. Hyperia Latreillii (*n. s.*) . . . . . Ibid.
252. Typhis monoculoides (*mag.*) . . . . Ibid.
253. Cerapus Whitei (*mag.*) . . . . . Living specimen.
254. Podocerus pulchellus (*mag.*) . . . . Specimen.
255. Corophuim longicorne (*mag.*) . . . . Living specimen.
256. Unciola irrorata (*mag.*) . . . . . Specimen.
257. Gammarus locusta (head *mag.*) . . . Living specimen.
258. Amphithoe rubricata (*mag.*) . . . . Specimen.
259. Leucothoe articulosa (*mag.*) . . . . Ibid.
260. Acanthonotus testudo (*n. s.*) . . . . Ibid.
261. Anonyx albus (*mag.*) . . . . . Ibid.
262. Opis typica (*mag.*) . . . . . Ibid.
263. Talitrus locusta (*n. s.*) . . . . . Living specimen.
264. Sulcator arenarius (*n. s.*) . . . . . Specimen.
265. Orchestia littorea (*n. s.*) . . . . . Ibid.
266. Amphithoe (Dexamine) spinosa (*n. s.*) . Ibid.
267. Cuma Edwardsii (*n. s.*) . . . . . Ibid.
268. Alauna rostrata (*n. s.*) . . . . . Goodsir.
269. Bodotria arenosa (*n. s.*) . . . . . Ibid.
270. Squilla Desmarestii ($\frac{1}{3}$ *n. s.*). . . . . Specimen.
271. Mysis vulgaris (*n. s.*) . . . . . Living specimen.
272. Themisto brevispinosa (*n. s.*) . . . . Bell.
273. Cynthilia Flemingii (*mag.*) . . . . Ibid.
274. Thysanopoda Couchii (*mag.*) . . . . Ibid.
275. Phyllosoma commune (*n. s.*) . . . . Specimen.
276. Penæus Caramote ($\frac{1}{2}$ *n. s.*) . . . . . Bell.
277. Pasiphæa Sivado ($\frac{1}{2}$ *n. s.*) . . . . . Specimen.
278. Palæmon squilla (*n. s.*) . . . . . Living specimen.
279. Pandalus annulicornis (*n. s.*) . . . . Specimen.
280. Hippolyte fascigera (*n. s.*) . . . . . Living specimen.
281. Athanas nitescens (*n. s.*) . . . . . Ibid.
282. Nika edulis ($\frac{1}{2}$ *n. s.*) . . . . . Specimen.
283. Alpheus ruber (*n. s.*) . . . . . Ibid.
284. Crangon vulgaris ($\frac{1}{2}$ *n. s.*) . . . . . Living specimen.
285. Nephrops Norvegicus ($\frac{1}{5}$ *n. s.*) . . . . Specimen.
286. Homarus vulgaris ($\frac{1}{6}$ *n. s.*) . . . . . Ibid.

Fig.
287. Calocaris Macandreæ (½ *n. s.*) . . . . Specimen.
288. Axius Stirynchus (½ *n. s.*) . . . . . Ibid.
289. Gebia stellata (⅔ *n. s.*) . . . . . Ibid.
290. Callianassa subterranea (⅔ *n. s.*) . . . Ibid.
291. Palinurus quadricornis ($\frac{1}{6}$ *n. s.*) . . . Ibid.
292. Pagurus Prideauxii (½ *n. s.*) . . . . Living specimen.
293. Munida rugosa (⅓ *n. s.*) . . . . . Specimen.
294. Galathea squamifera (½ *n. s.*) . . . . Living specimen.
295. Porcellana platycheles (*n. s.*) . . . . Ibid.
296. Dromia vulgaris (¼ *n. s.*) . . . . . Specimen.
297. Lithodes Maia ($\frac{1}{5}$ *n. s.*) . . . . . Ibid.
298. Corystes Cassivelaunus (⅓ *n. s.*) . . . Ibid.
299. Atelecyclus heterodon (½ *n. s.*) . . . Ibid.
300. Thia polita (*n. s.*) . . . . . Ibid.
301. Ebalia Pennantii (*n. s.*) . . . . . Ibid.
302. Planes Linneana (*n. s.*) . . . . . Ibid.
303. Gonoplax angulata (½ *n. s.*) . . . . Ibid.
304. Pinnotheres pisum (*n. s.*) . . . . . Ibid.
305. Polybius Henslowi (½ *n. s.*) . . . . . Bell.
306. Portunus depurator (½ *n. s.*) . . . . Living specimen.
307. Portumnus variegatus (½ *n. s.*) . . . . Specimen.
308. Carcinus Mænas (⅓ *n. s.*) . . . . . Living specimen.
309. Pirimela denticulata (*n. s.*) . . . . . Specimen.
310. Pilumnus hirtellus (*n. s.*) . . . . . Living specimen.
311. Xantho florida (⅔ *n. s.*) . . . . . Specimen.
312. Cancer pagurus ($\frac{1}{10}$ *n. s.*) . . . . . Living specimen.
313. Eurynome aspera (*n. s.*) . . . . . Specimen.
314. Maia Squinado (⅛ *n. s.*) . . . . . Ibid.
315. Hyas coarctatus (½ *n. s.*) . . . . . Living specimen.
316. Pisa tetraodon (½ *n. s.*) . . . . . Ibid.
317. Inachus Dorsettensis (*n. s.*) . . . . Ibid.
318. Achæus Cranchii (*n. s.*) . . . . . Specimen.
319. Stenorhynchus tenuirostris (*n. s*) . . . Living specimen.
320. Balanus porcatus (*n. s.*) . . . . . Ibid.
321. Acasta spongites (*n. s.*) . . . . . Specimen.
322. Pyrgoma Anglicanum (*n. s.* & *mag.*) . Living specimen.
323. Coronula diadema (½ *n. s.*) . . . . . Darwin.
324. Chthamalus stellatus (*n. s.*) . . . . . Living specimen.

Fig.
325. Verruca Strömia (*n. s.*) . . . . . Living specimen.
326. Lepas anatifera (*n. s.*) . . . . . Specimen.
327. Conchoderma virgata (*n. s.*) . . . . Darwin.
328. Anelasma squalicola (*n. s.*) . . . . . Ibid.
329. Alcippe lampas (*mag.*) . . . . . Ibid.
330. Scalpellum vulgare (*n. s.*) . . . . . Specimen.
331. Pollicipes cornucopia (*n. s.*) . . . . Darwin.
332. Halarachne halichœri (*mag.*) . . . . Allman.
333. Halacarus rhodostigma (*mag.*) . . . Living specimen.
334. Aepus marinus (*mag.*) . . . . . Specimen.
335. Micralymma brevipenne (*mag.*) . . . Ibid.

ALPHABETICAL INDEX

TO THE GENERA AND SPECIES IN PART I.

N.B. The names of Genera *are printed in Italics; those of* species *in Roman.*

Abbensis, 67.
abietina, 22.
acanthifera, 131.
Acanthonotus, 142.
Acasta, 172.
Achæus, 165.
Actinia, 29.
aculeata, 106.
acuminata, 137.
acuminifera, 131.
acuta, 129.
acutifrons, 131.
Adamsia, 27.
Adelosina, 14.
Ægа, 134.
ægagropila, 5.
Aepus, 180.
Æquorea, 47.
aeronautica, 45.
affinis, 150.
agglomerata, 35.
alata, 124.
Alauna, 143.
alba, 29, 100, 129.
albescens, 4.
albida, 30, 64.
albifrons, 136.
albo-maculata, 129.
album, 81.
albus, 142.
Alcinoe, 52.
Alcippe, 174.
Alcyonium, 35.
Alderia, 47.
Alderi, 5.
Allmanni, 28.
Alpheus, 150.
Alteutha, 127.
alveolata, 92.
amœna, 93.
Amphidotus, 70.
Amphithoe, 141.
anatifera, 174.
anceps, 36.
Anceus, 135.
Anchorella, 121.
Anelasma, 174.
Anglicum, 173.
anguicoma, 28.
angulata, 59.
angustata, 129.
Anomalocera, 127.
Anonyx, 142.
annulicornis, 148.
annulus, 95.
antennina, 24.
Antennularia, 24.
Anthea, 26.
Anthosoma, 123.
Anthura, 138.
antiquata, 129.
Aphrodita.
appendiculata, 44, 137.
Apseudes, 136.
araneus, 163.
Arachnactis, 30.
areolata, 4.
arcta, 23.
arctica, 20.
Arcturus, 138.
arcuatus, 160.
arenaria, 91.
arenarius, 142.
Arenicola, 97.
arenosa, 143.
argentea, 22.
armatum, 81.
armillaris, 102.
Arpacticus, 127.
Artemia, 129.
articulata, 24.
articulosa, 141.
ascidicola, 126.
asellina, 122.
aspera, 162.
astaci, 123.
Astemma, 81.
Asterina, 66.
Asterias, 67.
Astrophyton, 65.
Atelecyclus, 158.
Athanas, 149.
atomata, 80.
Audouinii, 143.
aurantia, 127.
aurantiaca, 67.
aurata, 43.
aurea, 5.
auricula, 32.
aurita, 48, 174.
aurora, 28.
Axius, 152.

Bairdii, 44, 91.
Balanophyllea, 33.
Balanus, 172.
Ballii, 64.
balanoides, 172.
Baltica, 108.
Barleii, 149.
Beanii, 21.
Beccarii, 12.
Belgica, 91.
bellis, 28, 64.
Bernhardus, 74, 154.
Beroe, 51.
bicarinata, 134.
bicolor, 124.
bicornis, 14.
bidentata, 135.
bilineata, 101, 102.
bioculata, 82.
bipes, 130.
bipunctata, 106.
bispinosus, 151.
blondina, 43.
boa, 104.
Bodotria, 143.

Bolina, 51.
Bopyrus, 132.
borealis, 33, 51, 106.
Borlasii, 82.
Boscii, 124.
botryoides, 6.
Bougainvillæa, 43.
brachiata, 64.
Brachionus, 109.
branchialis, 97, 121.
Branchiarius, 98.
brenda, 128.
brevimanus, 102.
brevipenne, 180.
brevirostris, 120.
brevis, 72.
brevispinosa, 145.
Brissus, 70.
Britannica, 43.
brunneus, 71.
Bunodes, 28.
Buskiana, 45.
Bryerii, 159.

cæruleata, 135.
calcarea, 97.
caliculata, 25.
caligorum, 89.
Caligus, 125.
Callianassa, 153.
callimorpha, 31.
Calocaris, 152.
campanula, 48.
Campanularia, 24.
campanulata, 32.
Campecopea, 135.
camptolops, 141.
Cancer, 162.
candida, 28.
Canthocamptus, 126.
capitatus, 96.
Capnea, 28.
Caprella, 130.
Caramote, 143.
carbonaria, 97.
Carcinus, 161.
carinatus, 95, 141.
carino-spinosa, 141.
carnea, 93.
carnosa, 5.
Caryophyllea, 33.
Cassivelaunus, 158.
Catharina, 24.
caudatus, 74, 109, 124.
Cecrops, 124.
celata, 5.
Cetochilus, 128.
centrodonti, 125.
Cerapus, 140.
Cerberus, 20.
cereus, 27.
cervicornis, 4.
Chalimus, 124.
chamæleon, 145.
chelifer, 127.
Chelura, 138.
chloræma, 94.
Chondracanthus, 122.
chrysodon, 93.
Chthamalus, 173.
ciliata, 6.
ciliatus, 97.
cinerea, 4.
Cirolana, 134.
cirrata, 105.
Cirratulus, 98.
cirrhata, 93.
Clava, 19.
clavata, 29.
Cliona, 5.
clypeata, 109.
coalita, 5.
coccineum, 120.
columbæ, 4.
coluris, 109.
Colurus, 109.
commune, 146.
communis, 95.
compressa, 6, 93.
concentrica, 13.
conchilega, 93.
Conchoderma, 174.
conicus, 95.
Conilera, 134.
coniocephala, 97.
constrictor, 93.
contortuplicata, 95.
conus, 5.
convexa, 129.
Convoluta, 80.
Coppinia, 22.
corallinoides, 5.
Cordineri, 95.
coriacea, 6.
cornucopiæ, 175.
cornuta, 80, 122.
Coronula, 173.
Corophium, 141.
corrugatus, 95, 160.
Corymorpha, 20.
Corynactis, 27.
Coryne, 20.
Corystes, 158.
Couchii, 146.
Cranchii, 134, 135, 141, 149, 159, 165.
Crangon, 150.
cranium, 3.
crassissima, 92.
crassula, 12.
crenaticornis, 97.
crenatula, 12.
crenatus, 172.
crispa, 12.
cristata, 24.
ctenopus, 177.
cuanensis, 154.
Cuma, 143.
cupressina, 22.
curta, 93.
curtum, 134.
curtus, 125.
Cyamus, 131.
cylindracea, 134.
cylindrica, 138.
Cynthilia, 145.
Cypridina, 128.
Cymodocea, 135.
Cythere, 128.
Cythereis, 129.

Danmoniensis, 134.
delicatula, 44.
deltura, 153.
Dentalina, 12.
denticulata, 161.
depressa, 127.
depurator, 160.
Derris, 98.
Deshayesii, 142.
Desmarestii, 144.
Dexamine, 141.
diadema, 173.
dianthus, 28.
diaphanus, 125.
dichotoma, 24.
digitalis, 45.
digitata, 73.
digitatum, 35.
dinema, 46.
Dinemoura, 124.
Diphyes, 52.
Diplotis, 99.
dissimilis, 71.
Ditrupa, 95.
Dorsettensis, 165.
Dorynchus, 165.
Dromia, 156.
Drummondii, 71.
dubia, 141.
ducalis, 46.
Dujardinii, 6.
Dulongii, 137.
Dumerilii, 102.
Dumortierii, 20.
dumosa, 25.
Dysidea, 6.

Eachana, 90.
Ebalia, 159.

ecaudata, 97.
Echinarachnius, 69.
echinata, 19.
Echinocyamus, 69.
echinulata, 24.
Echinus, 69.
Echiurus, 75.
edulis, 150.
Edwardsia, 31.
Edwardsii, 143.
elegans, 142.
elongata, 122.
emarginata, 134, 135, 137.
encrasicholi, 121.
endeca, 66.
Entosolenia, 11.
episcopalis, 46.
equestris, 67.
erraticus, 131.
Eudendrium, 20.
Eunice, 104.
Euphrosyne, 104.
Euphysa, 43.
Eurydice, 134.
Eurylepta, 80.
Eurynome, 162.
Evadne, 129.
Evansii, 22.

Fabricii, 93.
falcata, 24, 140.
fallax, 22.
fasciatus, 151, 154.
fascicularis, 32, 174.
fascis, 24.
femoratum, 120.
ficus, 5.
filicula, 22.
filiformis, 64, 82, 95.
Filograna, 95.
Finmarchica, 127.
fistulosa, 6.
flaccida, 82.
flaveola, 43.
flavida, 129.
Flemingii, 50,69,92,145.
flexilis, 80.
florida, 162.
foliosa, 104.
Forbesiana, 47.
Forbesii, 73, 74, 97, 154.
formosa, 43.
Forskallii, 47.
fragilis, 6, 82.
fragilissima, 67.
frondosa, 71.
frutescens, 24.
fruticosa, 4.
fucata, 102.
fucicola, 71, 141.
fucorum, 5.
fulgens, 51.
furcatus, 127.
Furcularia, 108.
fusca, 22, 101.
fuscata, 135.
fusiformis, 71.

Galathea, 155.
galba, 139.
Gammarus, 141.
Gebia, 153.
gelatinosa, 24.
gelatinosum, 92.
gemmacea, 29.
gemmifera, 42.
geniculata, 24.
Geodia, 4.
Geryonia, 44.
Geryonopsis, 44.
gibbosa, 45, 66.
Gibbsii, 164.
gigantea, 93.
giganteum, 120.
glacialis, 65.
Globigerina, 12.
globosa, 11, 45.
globosum, 120.
globulosa, 46.
glomeratum, 35.
Glossiphonia, 90.
Glycera, 100.
Goniaster, 67.
Gonoplax, 159.
Goodsiri, 64.
Gorgonia, 36.
gorgonioides, 5.
gracile, 81, 120.
gracilis, 5, 11, 20, 22, 42, 82, 131, 138.
Grantia, 6.
granulata, 65.
granulatus, 95.
granulosus, 74.
Grayana, 149.
Griffithsiæ, 134, 145.
grossa, 89.
grossimanus, 141.
grossipes, 120.
Gulielminæ, 12.

Halacarus, 177.
Halarachne, 177.
halecinum, 21.
Halecium, 21.
halichœri, 177.
Halichondria, 4.
Halisarca, 6.
halterata, 45.
Hameri, 172.
Harveii, 74.
hastata, 31.
hemisphærica, 45.
Henslowana, 73.
Henslowi, 160.
heterocera, 28.
heterocliticus, 95.
heterodon, 158.
heterostrophus, 95.
Hibernica, 51.
Hillii, 174.
hippoglossi, 90, 125.
Hippolyte, 149.
hippolytes, 132, 133.
hirsuta, 5, 135.
hirtellus, 162.
hirtipes, 134.
hirudo, 80.
hispida, 4, 65.
Holothuria, 72.
holsatus, 160.
Homarus, 151.
Hombergii, 101.
Hookeri, 134.
Howsei, 5.
hyalina, 71, 99.
Hyas, 163.
Hydractinia, 19.
Hyndmanni, 71, 154.
hyoscella, 48.
Hyperia, 139.
hystrix, 5, 106.

Idotea, 137.
Ilyanthus, 30.
immersa, 22.
impar, 105.
implexa, 95.
impressa, 129.
improvisus, 172.
Inachus, 165.
inconspicua, 45.
incrustans, 5.
incurvatus, 95,
indivisa, 20.
inflata, 12.
infundibuliformis, 4.
infundibulum, 50, 93.
inornata, 104.
integra, 25.
intermedius, 138.
interpuncta, 128.
intertexta, 25.
intestinalis, 72.
intricata, 95.
Ioida, 101.
Ione, 133.
iricolor, 103.
irrorata, 141.

Jæra, 136.
Johnstonella, 106.
Johnstonia, 4.
Johnstoni, 74, 93.
Jonesii, 129.

Kroyeri, 136.

lacerata, 24, 25.
lactea, 13.
lacteus, 71.
lacunosa, 6.
Læmargus, 124.
lævigata, 6.
lævis, 11, 25, 90, 131, 154.
Lagena, 11.
lagena, 50.
Lamarckii, 48.
lamelligera, 101.
lamnæ, 124.
lampas, 175.
Laomedea, 24.
larynx, 20.
Latreillii, 124, 139.
Leachii, 148.
lepadifera, 36.
Lepas, 174.
Lepeoptheirus, 125.
leptochirus, 165.
Leptomera, 131.
Leptoplana, 80.
Lernea, 121.
Lernentoma, 122.
Lerneonema, 121.
Lerneopoda, 122.
Leucodore, 97.
Leucothoe, 141.
limbata, 6.
Limnoria, 136.
linearis, 131, 137.
lineata, 11, 45, 103.
lineatus, 96.
Linneana, 159.
Lithodes, 156.
littorale, 119.
littoralis, 19.
littorea, 142.
lividus, 60.
Lizzia, 43.
lobata, 5, 131.
lobatula, 12.
locusta, 141, 142.
longicorne, 141.
longicornis, 138, 156.
longimanus, 141.
longipes, 160.
longiseta, 102.
longispina, 131.
longispinosa, 145.
longissima, 103.
lophii, 122.
Lucernaria, 31.
lucidus, 95.
lucifera, 45.
Luidia, 67.
lumbricalis, 93.
Lumbricus, 96.
lunulata, 50.
Lygia, 136.
lyncurium, 3.
lyrifer, 70.
Lysidice, 103.

Macandreæ, 152.
Macandrei, 128.
maculans, 5.
macularis, 5.
maculata, 45, 101, 135.
maculatus, 141.
maculosa, 103, 136.
Mænas, 161.
Maia, 156.
Maia, 163.
Malacobdella, 89.
mamillaris, 5.
mantis, 144.
margareta, 22.
margarita, 103.
margaritacea, 101, 103.
margaritifera, 30.
marginata, 11, 101.
Mariæ, 128.
marina, 90, 108.
marinus, 141, 180.
marmoreus, 160.
maxillaris, 135.
Medusa, 48.
medusa, 98.
medusicola, 90.
melanocephala, 82.
melanops, 45.
melo, 69.
membranaceus, 66.
mesembryanthemum, 30.
Microlymma, 180.
miliaris, 14, 69.
milletiana, 32.
miniata, 29.
minna, 129.
minuta, 65.
minuticornis, 127.
minutus, 95, 96, 125.
mirabilis, 34.
Mitchellii, 30, 149.
Modeeria, 43.
Moggridgei, 141.
molæ, 89.
mollis, 103.
monile, 29.
monoculoides, 140.
monophthalma, 134.
Monopus, 90.
Montagui, 4, 71, 95, 135.
Monura, 109.
Mülleri, 109, 125.
multicornis, 19.
Munida, 155.
muricata, 90.
muricatum, 21.
muricatus, 124.
Myriana, 102.
myriophyllum, 24.
Myriothela, 19.
Mysis, 145.

Næsea, 135.
nautilina, 12.
Nebalia, 130.
nebulosa, 93.
neglecta, 45, 64.
neglectus, 69.
Neillii, 71.
Nemertes, 81.
Nephelis, 90.
Nephrops, 151.
Nephtys, 101.
Neptuni, 75.
Nereis, 102.
Nerine, 97.
Nicothoe, 123.
nigra, 22, 72.
nigrescens, 129.
nigritella, 43.
Nika, 150.
Ninetta, 103.
nitescens, 150.
nivea, 6, 28.
nobilis, 127.
Noctiluca, 14.
noctiluca, 102.
nolens, 140.
Nonionina, 12.
Nordmanni, 125, 129.
Northumbrica, 5.
Norvegicus, 69, 151.
Notodelphys, 126.
nudus, 74.
nutans, 20.
Nymphon, 120.

obliqua, 24.
oblonga, 13, 14.
obscurus, 125.
obtusata, 141.
Oceania, 46.
oceanica, 136.
Ocnus, 71.
octocostatum, 46.
octoculata, 82, 90.

octopunctata, 43.
octona, 45, 46.
octotentaculata, 103.
oculata, 4, 65.
Oculina, 33.
olivaceum, 120.
Oniscoda, 136.
oniscoides, 104.
Onuphis, 103.
operculata, 22.
Ophiocoma, 64.
Ophiura, 63.
Opis, 142.
Orchestia, 142.
Othonia, 93.
ovalis, 131.
oxyurus, 75.

Pachymatisma, 4.
Pagurus, 154.
pagurus, 162.
Palæmon, 148.
Palinurus, 153.
Pallasii, 74.
Pallene, 120.
palliata, 27.
palmata, 4.
Palmipes, 66.
pandaliformis, 149.
Pandalus, 148.
Pandarus, 124.
papillata, 69.
papillosa, 6, 72.
papillosus, 74.
papposa, 66.
paradoxa, 81.
parasitica, 28.
Paretti, 101.
parmularia, 64.
parvula, 25.
Pasiphæa, 148.
Patersonii, 128.
Pavonaria, 34.
Pectinaria, 91.
pectinata, 174.
pectoralis, 125.
pedata, 131.
Pelagia, 48.
pelagica, 52, 102, 137.
pelagicus, 140.
pellucida, 129.
Penæus, 148.
penicillus, 93.
Pennantii, 159.
pennigera, 102.
Pentacta, 71.
pentactes, 71.
perforatus, 172.
peripatus, 101.
perlevis, 5.
pervius, 95.
phalangium, 168.
phantapus, 73.
phasma, 131.
Pholoe, 104.
Phoxichilidium, 119.
Phoxichilus, 119.
Phryxus, 133.
Phylline, 90.
Phyllodoce, 101.
Phyllosoma, 146.
Physalia, 52.
pictum, 120.
pileata, 45.
pileus, 50.
pilosella, 45.
Pilumnus, 162.
pinaster, 22.
pinnata, 22, 24, 36, 104.
Pinnotheres, 159.
Pirimela, 161.
Pisa, 164.
piscatorum, 97.
Piscicola, 90.
pisum, 159.
placenta, 69.
Planaria, 80.
Plancia, 42.
Planes, 159.
platycheles, 156.
plumosa, 92.
pocillum, 53.
Podocerus, 141.
polita, 158.
Pollicipes, 175.
Pollicita, 100.
Polybius, 159.
polyceps, 20.
Polymorphina, 13.
Polynoe, 105.
Polystemma, 81.
Polystomella, 12.
Polyxenia, 46.
pomiformis, 50.
Pontobdella, 90.
porcatus, 172.
Porcellana, 155.
Portlockii, 72.
Portumnus, 160.
Portunus, 160.
Praniza, 135.
Priapulus, 74.
Prideauxiana, 149.
Prideauxianum, 134.
Prideauxii, 154.
Primnoa, 36.
prolifera, 33, 42, 102.
Psamathe, 101.
Psolinus, 72.
Psolus, 73.
Pterodina, 109.
puber, 160.
pulchella, 6, 42.
pulchellus, 141.
pulchra, 134.
pulchrum, 81.
pulex, 141.
pulmo, 50.
pulsatoria, 103.
pumila, 22.
punctata, 45, 64, 103, 141.
punctatissimus, 74.
punctatus, 141.
purpurea, 82.
purpureus, 69.
pusilla, 20, 45.
Pycnogonum, 119.
Pyrgoma, 173.

Quadrangularis, 35.
quadrata, 45.
quadricornis, 153.
quadridentata, 129.
quadrioculatum, 81.
Quinqueloculina, 14.

rameum, 20.
ramosa, 4, 20, 24.
ramosum, 20.
rapax, 125.
raphanus, 72.
Rataria, 53.
recta, 12.
regia, 33.
renalis, 103.
reniformis, 93.
Reticularia, 22.
retortus, 95.
reversus, 95.
Rhizostoma, 50.
rhodostigma, 177.
rigida, 5.
rivulosa, 162.
Rocinela, 134.
rosacea, 22, 63.
rosea, 28, 46, 65, 94.
roseum, 81.
roseus, 70.
rostrata, 143.
rosula, 65.
Rotalina, 12.
rotunda, 52.
rotundata, 13.
rubens, 65.
ruber, 150.
rubra, 43, 135.
rubricata, 141.
rufa, 103.
rufescens, 96.
rufifrons, 81.

rugosa, 22, 95, 122, 155.
Sabella, 93.
Sabellaria, 92.
saburrata, 5.
Sagartia, 28.
Sagitta, 106.
salina, 129.
salmonea, 122.
sanguinea, 5, 28, 98, 104.
Saphenia, 46.
Sarcodictyon, 35.
sarnica, 45.
Sarsia, 42.
Savignyi, 137.
Scalpellum, 175.
Scolanthus, 31.
scolopendra, 106.
scolopendrina, 105.
scombri, 124.
Scoticus, 30.
sculptus, 151.
scutatum, 65.
seminulum, 14.
semisquamosa, 105.
septentrionalis, 128.
seriata, 5.
serpens, 25.
Serpentaria, 82.
Serpula, 94.
serratum, 134.
serratus, 148.
serrulata, 95.
Sertularia, 21.
sessilis, 20.
setacea, 24.
seticornis, 97.
setiformis, 114.
sevosa, 5.
Sigalion, 104.
simulans, 4.
Siphonostoma, 92.
Sipunculus, 74.
Sivado, 148.
Slubberia, 45.
Smithii, 33, 52, 123.
Solaster, 66.
Spadix, 19.
Spatangus, 69.
sphæra, 69.
sphæroides, 31.
Sphæroma, 134.
spinosa, 141.
spinosus, 119, 151.
Spinther, 104.
spinus, 149.
Spio, 97.
spirillum, 95.
Spiroloculina, 13.
Spirorbis, 95.
Spongia, 5.
spongicola, 172.
spongites, 172.
spratta, 121.
squalicola, 174.
squamata, 105.
squamifera, 155.
squamosa, 11.
Squilla, 144.
squilla, 148.
squillarum, 132.
Squinado, 163.
stagnalis, 80.
stauridia, 20.
Steenstrupia, 43.
stellata, 47, 153.
stellatus, 173.
Stirynchus, 153.
Stomobrachium, 46.
striata, 11.
striatulus, 95.
strigosa, 155.
Strömia, 174.
Strömii, 125, 127.
subarenata, 12.
subcylindrica, 91.
suberea, 5.
subrotunda, 14.
substriata, 11.
subterranea, 153.
subulata, 95.
Sulcator, 142.
surirea, 48.
Syllis, 102.
Synchæta, 108.
syringa, 25.
Syrinx, 73.

Talitrus, 142.
talpa, 136.
tamarisca, 22.
Tanais, 136.
Temora, 127.
Templetoni, 67.
tentaculatus, 98.
tenuicinctus, 74.
tenuirostris, 166.
Terebella, 93.
terebrans, 136, 138.
testudo, 142.
Tethea, 3.
tetraodon, 164.
Tetrastemma, 81.
texturata, 64.
Thalassema, 75.
thallia, 29.
Thaumantias, 45.
Thia, 158.
Thompsoni, 45, 125, 131, 149, 154.
thoracicus, 133.
thuia, 24.
Thuiaria, 23.
Tima, 44.
Titania, 46.
Tomopteris, 106.
Travisia, 97.
Trebius, 124.
tremellaris, 80.
tricuspidata, 137.
tridens, 134.
trilineata, 82.
Triloculina, 14.
triquetra, 95.
trispinosa, 143.
trispinosus, 151.
Tristoma, 87.
troglodytes, 28.
truncata, 135.
Truncatulina, 12.
tuberculata, 131, 162.
tubicola, 103.
tubifex, 102.
Tubularia, 20.
tubulosa, 42, 72.
Tuediæ, 27.
Turbinalia, 32.
Turris, 45.
turrita, 46.
Typhis, 140.
typica, 142.

Udonella, 89.
ulidianus, 154.
uncinata, 122.
uncinatum, 92.
uncinatus, 109.
Unciola, 141.
undulata, 45.
unicolor, 82.
Uraster, 65.

variabilis, 129.
varians, 148, 149.
variegatus, 141, 161.
vastifica, 5.
Velella, 52.
ventilabrum, 4.
venusta, 28.
venustula, 93.
vermicularis, 95.
Verruca, 174.
verrucosa, 36.
versicolor, 103.
verticillata, 25.
vesiculosa, 93.
vestitum, 92.
veterum, 159.
viduata, 28.
violacea, 65.
virgata, 174.

Virgularia, 34.
virgultosa, 5.
viridis, 28, 101, 102, 105, 135.
vitrina, 47.
vittata, 80.
volubilis, 25.
volutacornis, 94.
vulgare, 175.
vulgaris, 52, 97, 151, 152, 156.
Whitei, 129, 140, 149.
Willsia, 47.
Xantho, 162.
Yarrellii, 149.
zei, 122.
Zetlandica, 4.
Zoanthus, 32.

END OF PART I.

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